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Alphabetical Index of Advertisers
Page 16

Vol. 28 **July 1, 1914** **No. 26**

Principal Contents

The Season of Speech ... 827
Engineering Critics ... 828
Engineering Topics in the Old Land ... 829-30
London, Eng., Correspondence of the Contract Record
Some Observations on the First Draft of the Town Planning Act ... 831-4
By R. O. Wynne-Roberts
Cost of Constructing and Operating Slow and Rapid Sand Water Filtration Plants ... 834-8
Proposed Hotel Imperial, St. John, N.B. ... 838-9
Extensive Buildings for the Canadian Kodak Company, Limited Toronto ... 838
Reinforced Concrete in Theory and Practice (Conclusion) ... 840-2
By Alexander Melville, C.E.
Economical Proportioning of Concrete ... 842
Reinforced Concrete Bridge at Toronto ... 842
How to Patch a Concrete Floor ... 842
Proposed Mormon Temple, Cardston, Alta. ... 843
The World's Highest Office Building ... 843
Ontario Commissioners' Valuable Report on Highway Administration ... 844-8
Methods and Cost of Constructing a Bituminous Gravel Concrete Surface ... 848
Cracking in Concrete Roads ... 849
Violet-Ray Sterilization for Niagara Falls Filters ... 849
Municipal Engineering Work at Hamilton ... 850
Constructional News from the Saskatchewan Capital 851-2
Personal Mention ... 853
Constructional and Industrial News ... 854-6

The Season of Speech

SPEECH has no season. The need of some method of concealing thought is ever a pressing one, and speech is a method which never fails. The loquacity of silence is too earnest, too deep, for everyday purposes. Commonplaces, forced sentiments, truisms (and other falsities), vapidities and conventional phrasings roll well off the tongue; and it is questionable whether their due presentment were possible by any other vehicle. To commit one's thoughts to cold print is to risk fame, for print is in its way imperishable and may rise in testimony at any moment. Speech is transitory, of the moment, and every word that has been uttered may be discovered. Speech (or sound) and false coin are, by the way, the only things to which the word "utter" is applied, and the analogy is obvious. There is, of course, ever the risk that one's words may be taken down by some zealous reporter and used in adverse evidence; but the intricate system of hooks and dots and halvings for which Pitman is responsible may always be urged as a plea for exculpation, and leavened with a dart of virtuous indignation will result unfailingly in a verdict of not guilty.

So much by way of preliminary flourish, from which the reader may draw what moral he pleases. There is a certain engineering institution in London, which has one very interesting unwritten law, viz., that at its social functions speech-making shall be taboo. The chairman is allowed, at the conclusion of the meal, to rise upon his feet, glass in hand, and say "The King," following it up immediately by "Gentlemen, you may smoke." Other institutions, other manners; and there are not wanting those—indeed, they are in a huge majority—which prepare lengthy toast lists, with dual responses, in which every possible opportunity is afforded for gentlemen to "say a few words." Three loyal toasts (necessarily without response) are not uncommon, and chairman, visitors,, kindred societies, secretary, the ladies, the press, mayor and corporation, and the city follow in heterogeneous profusion. Interspersed among these toasts are musical items provided by ladies and gentlemen of mediocre talent for the relief of a bored audience whose patience would become absolutely exhausted were it not for this ringing of the changes.

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After-dinner speaking ranks, according to some authorities, among the fine arts, and it is a pity that an attempt at cultivation is not made by those who rise to their feet upon the least provocation. The great secret of public speaking is to know when and how to finish. The veriest numbskull possesses the ability to utter a few lame sentences, but his difficulty is to round them off and to sit down without a jerk. The fluent speaker is able to roll off platitudes and insincerities by the score, but even he flags towards the end, and with a half-muttered "I think that's all I have to say," sinks into obscurity once more, leaving an impression the reverse of favorable behind him. The man of real intelligence rattles out what first presents itself and may talk a heap of twaddle, but he has his peroration up his sleeve all the time, and delivers it with hammer-like effect just as his audience is at the last gasp. It may be an anecdote, a personal recollection, a witty rejoinder to a former speaker, a rub at the chairman—the whole point is that it hits its mark and produces a round of applause. A very good rule to follow is to inform the press beforehand that a copy of the speech will be given to them. The reporters gladly close their books and their ears, bored as they are with the in-

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cessant round of talking that is nightly their lot. The speaker is then free to talk just as he pleases, secure in the fact that what he will give to the press bears no necessary relation to that, but is merely a carefully prepared record of what he would have said had it been good form to read his manuscript.

The fact of the matter is that after-dinner speaking bids fair to become a public nuisance, if it has not already attained to that eminence. The drastic rule of the institution mentioned above might be imposed all round without conceivable loss, but anyway a time limit should be imposed, and the man who can't propose the health of a mayor or the mayor who can't say he's "very well thank you" in the course of a five minutes' speech should be silent for ever. The question of "good form" enters into the matter, too. No man would invite a friend to dine at a public restaurant, and entertain him with diatribes on sewage disposal or surface tarring. But the engineer, **qua** engineer, appears to be shameless. He will invite ladies to his society's dinner and surfeit them with speeches on the most uninteresting and unsociable subjects. A dinner, a conversazione, or a social evening is not an occasion for speechifying. Some amount of courtesy is due to the visitors, who can even dispense with the customary vote in their favor. The fact that they have been invited is a sufficient indication that their presence was desired, and no amount of effusive outpouring from the surcharged bosom of a bursting declamator can compensate them for the boredom that is inflicted upon them.

"Too Busy to Read"

HE is a familiar type—the fussy, fretful man who imagines that he is about the busiest fellow in town. He often dumps in the waste-basket, unwrapped, copies of business or technical magazines that contain valuable articles bearing directly on his problems. He fondly believes that he is too busy **practising** to bother with what others are **preaching.**

The trouble with this type of man is that he has not learned that the real executive is the man who so plans his work as to leave a reasonable amount of time for reading and planning.

There are shoals and breakers ahead when the accumulation of new ideas ceases.

The man who declares he has no time to read is unconsciously advertising his small calibre, his slavery to detail, his arrested development.—Printer's Ink.

Where the Laborer is Not Worthy of His Hire

WE wonder what kind of a sewage works manager they expect to get in England for the princely stipend of $8.75 a week! The job is advertised by the Hungerford Rural District Council in a recent issue of the "Surveyor." Applicants are required to furnish testimonials and to have had experience in the working of air compressors and ejectors. No attempt is made to conceal the figure at which the lucky "applicant" will be engaged. It is set forth in cold, convincing type—"Wages, 35s. per week."

The salaries offered technical men in the old country have been criticized in these columns before, but not for some years, and it is with some curiosity that we consult the advertisements of our contemporaries for late information.

We find the Cannock Urban District Council inviting applications from qualified persons for the appointment of Surveyor's Assistant—at a salary of ten dollars a week, the applicants "to be capable of making surveys, preparing plans and details and to have a thorough knowledge of the routine work of a municipal surveyor's department." Surely by way of a little pleasantry—not as an incentive to academical distinction—they add: "Preference will be given to candidates who hold the Certificate of the Institution of Municipal and County Engineers and who have had experience in setting out and measuring up important works."

One cannot help speculating as to what the younger generation of English municipal engineers do in their spare time. It is hardly to be wondered at that poker and other games of chance are not gaining ground in the old country.

Engineering Critics

IN literature and in art we have critics who are recognized for their ability to pick out inaccuracies and defects. These critics certainly are not the most beloved of persons, yet they are needed and do much to insure better literature and better art. Their adverse criticism is feared while their favorable criticism is much desired, and as a result writers and artists feel the necessity of putting forth their best efforts.

We now have a few public spirited engineers who are giving considerable attention to criticisms of some present tendencies in engineering practice. They realize, as do most of us, that adverse criticism, even though merited, is apt to be little appreciated by practicing engineers and that such criticism does not tend to increase their personal popularity. That these men have the courage to voice their convictions is to be commended. This kind of work requires true courage and unselfishness, and the only men who can accomplish much in it are those who are recognized as having a sound knowledge of engineering principles supplemented by long and practical experience. There is a tendency on the part of some engineers to feel that any adverse criticism of their work is a personal insult, as they do not seem to realize that their success or failure must be borne largely by the engineering profession.

In the past many engineers were loath to permit the publication of any part of their plans or any description of methods used by them. This was due to their desire to avoid publicity, to the feeling that their work was their personal property, or to the fear of adverse criticism of their designs. Engineers and contracting firms are just beginning to appreciate fully that such narrow views constitute a mistaken policy and often serve to retard their progress. We know of many successful firms who are entirely willing to make public intimate details of methods and systems used by them, and thus be judged by their work. On the other hand, the structural engineer for a building which recently failed during construction informed us that he had copyrighted the plans of this building and would prosecute anyone who published any part of them. Most engineers, however, will grant that they have little right to success unless they are willing to stand on the merits of their designs.

By the term "critic" we mean one who is skilled in judging of the merits of engineering work; and we believe there are too few of such men who are willing to give the engineering profession the benefit of their opinions. New engineering data are constantly being published and new formulas suggested, and it is to be regretted that such information does not bring forth more discussion from experienced engineers. The tendency is to accept experimental data and to make them the basis of engineering practice without careful analysis. A number of our present rules and so-called working formulas possess little merit. They may, perhaps, save a little time, but such a saving is usually made at the expense of efficient designing. We do not advise every engineer to voice his criticism of engineering practice and its problems, but competent, public spirited engineering critics are needed.—Engineering and Contracting.

Engineering Topics in the Old Land

Practice and Malpractice in the Field of Sanitation: Canadian and English Methods Compared — The Ramifications of Labor

Special London, Eng., Correspondence of the Contract Record and Engineering Review

IN the last issue of the Journal of the Royal Sanitary Institute there appeared an interesting article by Mr. F. J. Osborne Smith, of the Public Works Department, Ottawa. It dealt with drainage and sanitary fittings in Canada, and was accompanied by a reproduction of the diagrams supplied by the Ottawa Local Board of Health to licensed plumbers as explanatory of the by-laws regulating plumbing. The main difference between English and Canadian practice is the abolition (in the case of the latter) of gullies at the feet of waste pipes and the fixing inside the building of all pipes, both of these departures from "recognised" methods being necessitated by climatic conditions. Putting these conditions on one side, however, the abolition of the gullies, over which wastes must discharge in the open, is a distinct advantage. The average gulley forms a miniature cesspit, and Mr. Smith is right when he says "it behoves sanitarians to give this matter careful thought and attention with a view to removing these defects in the English system of house drainage." Curiously enough, in view of this opinion concerning "the foul and evil-smelling gullies in England," Mr. Smith retains in his system that much fouler and more evil-smelling contrivance known as a fresh-air inlet. "Provision must be made for it," he says, and he specifies that it shall be "connected near the trap, and taken outside and fixed as far as possible from any opening into the house, terminating at least 18-in. above ground, and left open or covered with a cap having an area of one-fourth more than that of the pipe. When left open," he adds, "it is usually fitted with a semi-circular bend, fixed vertically."

The Fresh-Air Inlet

There is nothing more pathetic in the history of sanitary science than the world-wide belief in the continuous upward flow of drain air. The system advocated by the scientists is simplicity itself. Connect a short pipe to one end of the drain and a long pipe to the other, and—"up she goes." Questions of temperature, humidity, air currents, friction, and all that sort of thing, simply do not enter into the calculation. The outside air rushes into the short pipe but never into the long, and conversely, the inside or foul air rushes out of the long pipe but never out of the short. And in its passage, this outside air carries with it the foul air that would otherwise accumulate in the pipes and force the traps. It having been proved to the satisfaction of the scientific mind that an inlet (being fixed at a lower level) cannot act as an outlet, various forms of valves—of mica, aluminium or other light substance—have been devised, to prevent the emission of foul air from this very fitting; and really (following up the argument) why should not another valve be fixed at the apex of the ventilating shaft to prevent the introduction of fresh air at that point? The ventilation system would then be doubly guarded, while a further guarantee would be afforded (to the scientific person) by the fact that as these valves never by any possibility act at all as they are intended to no harm could be done by their introduction. Mr. Smith does not appear to recommend the use of these valves, and it is surmisable therefore that he has had experience of them. It is no uncommon sight in London and other large English towns to see the street urchins playing around so-called fresh-air inlets—busily engaged in poking sticks and stones between the bars of the protective grating, while the drain air is olfactorily visible to the most casual passer-by. Among men of sterling commonsense ranks high the householder who in defiance of the local sanitary authority, **trapped** his fresh-air inlet.

Sewer Air

Among text-book writers the faculty of imitation is held in great esteem. What one writes another copies, and an error once set down in print is successively duplicated throughout all time. The obsession concerning the fresh-air inlet is a case in point, and another is afforded by the insistance with which, in spite of recent developments, the retention of the sewer-gas interceptor is urged. A Departmental Committee of the Local Government Board of England has said in so many words that sewer gas is for the greater part innocuous except for its smell; nay, that it has been found, bacteriologically—oh the magic of that word—and chemically to be purer ofttimes than the ordinary atmosphere. Such a statement is so startling that the writer feels compelled to quote from the Report of the Committee. "In sewers, whether old or new, ventilated or unventilated, in which sewage is moving and is not lying stagnant, the air differs but little from that of the atmosphere outside. . . . . If it (sewer air- possessed no smell, it would not do the least harm or cause ill-health. . . . . The number of microbes to be found in sewer air is usually less than the number to be found at about the same time in the atmosphere outside the sewer. . . . . The microbes collected from the fresh air were about three times as numerous as those collected from the sewer air. . .. . . Many of these investigators have arrived at the conclusion that microbes found in sewer air are derived not from the sewage at all, but from the air outside the sewer. . . . . It is in the case of bad sewers that the number of sewer air microbes would appear to be at a minimum." It would not be fair to say that the Committee officially and formally endorsed all these statements, but the following, from their "Summary & Conclusions," is startling enough in all conscience: "The entry of sewer air, into a house, is of correspondingly smaller importance, bacterially, than the entry of drain air."

Drain Air

The opinion in England as to the merits and demerits of the intercepting trap has, however, no concern with the matter under review, but it is noteworthy how little notice is taken of the solemn pronouncement of a Government Departmental Committee. Engineers are beginning to lose faith in expert committees, and especially in the medical expert committeeman. The fact is to be deplored, as guidance of some sort is necessary in these days of swift-changing opinion and the unceasing introduction of new appliances and methods. A more careful and more judicious (and less avuncular) selection of the members of Departmental Committees and Royal Commissions is desirable, if their recommendations and conclusions are to have any weight. While refreshing his memory on the Departmental Report the writer came across the following: "With few exceptions, the evidence before us was unanimous that the air-inlet is an objectionable feature of the house drainage system." If, as has been quoted above, drain air is worse than sewer air, it certainly is not only an objectionable but a highly dangerous feature of a drainage system. Writers of text books, however, still continue to plump for the old system, filching paragraphs from one another with an impartiality both admirable and amiable.

The Masterman

There has been much fluttering in building dovecotes anent the decision of the Theosophical Society to have their new building completed under direct trade union supervision. There is talk, too, of other contracts going in the same direction, the men being quite ready to return to work were they allowed to do so under their own conditions. The matter is one that would vitally affect every contractor—whether building or engineering—if it were practical politics. But it must surely be many years before trade unions can so organize as to be in a position to take the place of the contractor. Mr. E. Guy Dawber, one of the best known English architects, puts the case fairly when he says: "It is like attempting to navigate a ship without the assistance of the captain. Suppose the men's Federation succeed in getting rid of the master builder it will also mean that competition will be got rid of and there will be no safeguard for anybody who wishes to have a building erected; for there would be nothing to prevent the unions saying: "Now we have got a monopoly; our men's wages at present are one shilling per hour; we want one shilling and sixpence." Where would it all end? Then again trades unions, under the Trades Disputes Acts, are above the law, and could not be sued for damages if contracts were not properly carried out. While trades unions enjoy this privileged position, would they be supplied with material by builders' merchants? And if they did get materials, where is the money to come from? No money is advanced before the job is begun; it is only advanced at the rate of 80 per cent. on work done and fixed on the premises. If a building is begun and turns out a loss, who is to be responsible? The Union? Would they pay or would the client suffer? In the case of contractors they lose and whistle, but agreements could not be made with the unions, as they are above the law." Still, it behoves contractors in every part of the world to keep themselves posted in events which are moving now in so many surprising directions. The building of the Theosophists (and it is a big job, too) is to be carried out under direct supervision, and even although this is due largely to the peculiar influence and advanced opinions of Mrs. Besant, the principle is capable of extension. Too, several architects, tired of the eternal dispute between masters and men (and regardful only of their clients' interests) are contemplating the employment of direct labor (to be supplied by the Federation) with the consequent exclusion of the contractor. Labor (in England, at least) has the bit between its teeth.

There is now under construction in Victoria, B.C., a reinforced concrete trunk sewer about 2 miles in length which is to drain about 425 acres in a rapidly growing residential section of the city, as well as 1,000 acres in Esquimalt and 800 acres in Saanich. The sewer starts with a 27-in. diameter and increases to a 36-in. pipe at the outfall near Macaulay point, where tidal currents were deemed favorable for disposal without nuisance. For several hundred feet near the lower end of the sewer steel pipes were used, and were continued to a discharge below water level. The remainder of the line, however, consists of reinforced concrete pipe, cast in 5-ft. lengths. In laying the pipe there are required about 3,100 ft. of trench, largely in rock, and 7,250 ft. of tunnel, practically all in solid rock. The tunnel work is comprised in three separate bores ranging up to 65 ft. in depth below the natural surface, and known as tunnels, X, Y and Z. The first of these tunnels is now being driven with the aid of two shafts sunk from the surface above. This tunnel is 7 ft. high by 5 ft. wide, and is being advanced at the rate of about 5 ft. per day. About 135 men are now engaged on the work.

In view of the almost absolute cleanliness associated with porcelain and like surfaces, states the Railway News, a suggestion has been advanced that the present absorbent wood and iron-built carriages should be replaced by steel and porcelain construction, non-absorbent materials which will not carry germs and bacilli. Steel-frame coaches should be used, with panels of plate porcelain for floors, partitions, ceilings, etc., aero metal door and window frames, rust-proof steel laths for strength of the floors, and asbestos copper-coated tape for joints. The upholstering to be movable, so that it can be properly fumigated in the compartment. The use of porcelain is ideal, in that the whole train can be washed inside and outside. A steel frame and porcelain vehicle can be washed out easily once a week or when necessary with carbolic acid or any other disinfectant. Rules and regulations, maps, names of stations, notices, etc., may be burnt in under the glaze and the smooth hard surface impervious against mischievous alterations. Similar methods may also be utilized for station buildings, with porcelain panels glazed and decorated on both sides with the advertisements burnt in under the glaze.

28(26) 1914.

Some Observations on the First Draft of the Town Planning Act

By R. O. Wynne-Roberts, Regina

Editor Contract Record and Engineering Review:

The Commission of Conservation through their committee on Town Planning Legislation are to be commended for submitting their draft Town Planning Act to the International Town Planning Convention held recently at Toronto, as it afforded the American delegates an opportunity of studying Canadian conditions and sentiments and at the same time gave the Canadian delegates a chance—limited though it was—of discussing this important matter before it was presented to the administrative governments of the provinces.

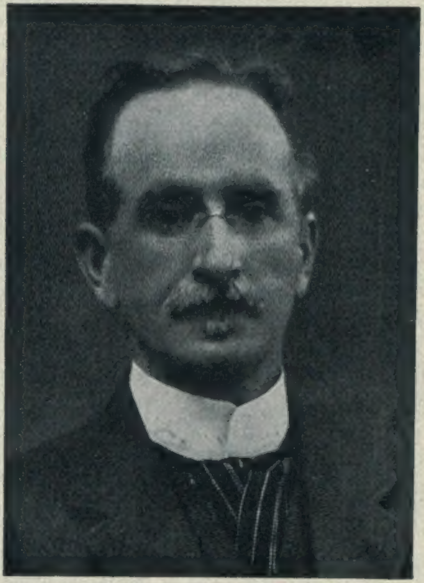
It was anticipated that Mr. Thos. Adams, of London, Eng., would lead off by discussing the draft measure, but instead he devoted most of the evening to a lecture on the principles of town planning. The information he imparted was excellent, but he refrained from making a single criticism of the draft act. In this, Mr. Adams was probably wise, for his limited acquaintance with Canadian conditions and requirements might easily have led him into technical difficulties; and even had he adopted safe grounds of argument, it might not have carried the same conviction as in the home land. Mr. Adams is a recognized authority on city planning and has studied the subject from many points of view in various countries. Nevertheless it is a matter of regret that he did not offer some observations as to the strength or weakness of the proposed Act as it appealed to him, for it must be admitted that dilating on the subject in an abstract manner, as he did, furnished no concrete reasons for amending the draft.

Dr. Hodgetts and his colleagues were somewhat apologetic in their references to the draft. They desired the delegates to understand that it was incomplete and in some ways inadequate. Dr. Hodgetts expressed a desire to see city planning carried out by authorities independently of the aldermen. This was animadverted upon by Hon. George Langley.

The draft bill contains fourteen sections, several sub-sections and two schedules. It provides for a Central Board, under the provincial departments of municipal affairs, consisting of a paid Town Planning Comptroller (chairman) and five others, who are heads of various other departments of provincial governments, although it is noticeable that the Deputy Minister of Municipal Affairs is not mentioned. Bearing in mind the undesirability of multiplying departments or boards with which the municipal authorities will have to work—each with its own specific requirements and each dealing with various phases of work—and that in some provinces the work may not be particularly onerous, it would appear to be reasonable to place this work in charge of the Local Government Boards where they have been created—for reasons that will be apparent later on.

It is also proposed to empower the municipal authorities to create local Housing and Town Planning Boards, consisting of the Mayor, Engineer, Medical Health Officer and two ratepayers, the latter preferably a financier and an architect. No further reference was made in the bill to the subject of housing. It is understood that it will be covered by another draft bill.

In the first place there is no limitation set as to the size of the village, town or city where this Board must be created. The term "municipal authority" covers every class and size, and therefore all are included. It is admitted that town planning is most desirable at the earliest stage of the growth of a village, for what is done then determines conditions for practically all time. It is apparent that such an Act would be a dead letter in a large number of places, because there are a much greater number of villages than towns and more towns than cities. It will be a dead letter because of the absence of men with the foresight and calibre required to perform the functions of their office and in the absence of any desire to formulate a scheme which will involve the expenditure of money. Villages are planned and laid out before there are many people living there. When a few do form a community, additional sub-divisions are often made without control; neither is there the desire to interfere on the part of the local people. The main hope is to see their village grow and nothing will be done which may in any way militate against such desired development. It is easy to conceive how land speculators can impress upon a few residents the importance of expansion. The draft bill may perhaps prove of service in towns and villages where the evils of excessive sub-division and inadequate provision for future local requirements are experienced and there is some measure of public opinion supporting the local board in making legitimate use of the powers conferred upon them. In small places it will be difficult to secure men wholly disinterested and willing to place their services at the disposal of their village. Architects of experience do not usually reside where



Mr. R. O. Wynne-Roberts.*

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*Mr. Wynne-Roberts, consulting engineer, Regina, has originated many important constructional schemes in Western Canada, among these being the project of the Regina Water Supply, which involved an outlay of $2,000,000. He has had extended experience in many parts of the world and as City Engineer of Capetown was in charge of a large water-works scheme which represented an outlay of $8.500,000. A sketch of Mr. Wynne-Roberts' career was published in the May 14, 1913, issue of the Contract Record and Engineering Review.

there is little work; neither do financiers locate where they do not find much scope for their business. Still, architects residing in small towns are naturally keen after business and if their clients are not imbued with great ideals the architects must, of course, abandon theirs. Financiers are often associated with the exploitation of lands for profit, and until they can see that town planning is an actual source of profit they will continue to follow the old ways. So that outside of the larger cities it is more than likely that a local board, constituted on the lines suggested will nullify the objects to be attained. It may be submitted that for towns having a population of less than, say, 10,000, the control of town planning might be reposed in the Central Board itself—that is to say, the municipal authorities of smaller towns would be guided by that board and not by a local board, which, owing to conditions inherent in many smaller towns and villages might become perfunctory and unsuccessful.

Moreover, it is proposed that each municipal authority shall create a separate local board to administer the Act. Such board will be non-elective and presumably, therefore, independent of public opinion and of the electors' vote. In the nature of our municipal constitution it is a question whether it is a good policy to establish such a system, for it tends to abolish popular control, which, in these days of democratic government—however defective it is—will bring about personal, interested and rancorous criticism—which is a condition worth avoiding. And, furthermore, it is desirable that popular government should be strengthened by persistent education and intelligent agitation, rather than cut into the ordinary prerogatives of authorities already established. It is worth noting that the men who are to constitute the local board are to consist of two officials whose tenure of office depends on the goodwill of municipal council: the mayor, who has annually to solicit the electors' support, and two ratepayers who are to be co-opted. It is improbable that any of these will take a determined stand to carry out any scheme, if it should meet with serious opposition. And if this should happen to be the case, in what superior position is the local board to the municipal council.

The local board shall have a permanent Housing and Town Planning Commissioner, which may be dismissed only by consent of the Central Board. This official will hold a unique position, for whilst his employers may be dismissed or ousted from office, he will remain. The remarks made as to the size of towns also apply here, for very small towns cannot afford to employ a Commissioner skilled in town planning, to attend to these duties only. Many towns do not employ engineers and some are without medical health officers, except in a nominal capacity. If it were possible to combine several towns into a district, a Commissioner might be employed without imposing a serious financial burden, and with greater security and efficiency.

Section 4 states that a town planning scheme may be prepared, which of course implies that it is optional, but Section 11 empowers the Central Board to order the preparation and submission of a scheme for approval, where the local board has failed to do so, and again in Sub-Section 3 of Section 2 the Central Board may apply for a mandamus to enforce compliance, and presumably carry out the work itself if the local board should stubbornly neglect its duty. Optional acts are often drafted with the best intentions, but are equally often non-operative because many interests come into play to thwart good movements. To ensure to the public the benefits of a general application of the act it should be obligatory in a manner similar to public health acts, otherwise one enlightened city will adopt the act and use the powers it confers and derive the advantages—if any—whilst others will ignore it until forced by one reason or another to do likewise. Meanwhile the evils it is proposed to remedy are somewhat aggravated.

The draft act provides for the preparation and approval of schemes within and without any municipality where land has already been built upon, or is likely to be used for that purpose, and once the schemes have been approved of they will have full force and effect and can only be varied or revoked by the approval of a subsequent scheme, of which due notice shall have been given to the public by advertisement. These powers appear to be adequate.

Further, the Central Board shall have powers to draft regulations to secure co-operation of the local board and the land owners. This is similar to the British Town Planning Act of 1909, but the conditions in Canada are dissimilar. In Great Britain the bulk of the land is owned by relatively a few persons, whereas in most parts of Canada land is owned by a multitude of small owners, many of whom do not live in the locality and only hold the land for incremental values. Any Canadian city may be selected and in and around it there will be found a large number of properties many of which are owned by non-residents, who are impressed only by possible appreciation in value. It will be difficult to arrange for co-operation in these cases—highly desirable though it may be. The writer thinks that the German enactments seem to be more adaptable for such a phase of town planning. The local authority under German laws decides on a scheme and if co-operation is secured, well and good, but in any case the scheme is put through, and each owner who has had his land re-subdivided receives an equivalent value of land. In many instances he gets land which is much more useful for building purposes. Town planning schemes, well thought out and arranged according to the need of the locality, will tend to improve the value of the properties affected. Whilst it may disturb the original subdivisions and some owners may be adversely affected, it is only by plenary powers that the desired consummation of town planning can be attained.

Anomalous Provisions

If in Sub-Section 5 it is intended that "the execution of any works" means sewers, water mains, street railways, etc., for those parts included in the scheme, then there will be dual authorities attending to such duties. It is contended that the local board should not actually carry out any work further than laying out of the street lines and making provision for the requirements of the district under consideration, otherwise there would be abundant source of friction between the local board and the municipal authority. Sub-Section 7b of Section 5, however, states that the local board shall prepare plans of the territory, showing tentative schemes for facilitating the development of permanent improvements in sanitation, transportation, conservation and beautification of the municipality, and that it shall carry into effect as opportunity arises such portions of the improvements as its financial resources will permit. There is therefore not much left for the existing municipal council to attend to, except routine administration and to find the money, and also to meet opposition and criticism on behalf of the local board which they created. Such a situation can scarcely be satisfactory to either body.

A perusal of Schedule A will again suggest that the local board will supplant the municipal council in the execution of public works as far as they relate to town planning. If all the works mentioned in this schedule were carried out by the local board, then it would be necessary to employ the City Engineer and other officials or to employ a separate staff. In all cities, except the large ones, a separate staff would be out of the question. So that the same officials would attend to local board and municipal council, with the anomaly that in the former the city engineer would be a member of the board and in the latter an official of the council. Further, as the local board will always be at least three-fifths municipal council men, why constitute a separate board at all? If a separate board is necessary, it should have a direct and independent mandate from the ratepayers, similar to School Boards, etc.

Administration of Funds

With regard to funds, it is to be noted that the local board in the absence of special provision in any town planning scheme, must not assess property without the authority of the municipal council. Nor can money be borrowed or any bonds be issued without such consent and the approval of the Central Board. In Saskatchewan it will also require the sanction of the Local Government Board. The municipal council, therefore, ca veto any scheme by refusing to furnish supplies unti the local board has statutory powers to levy rates. Reference has already been made to the question of placing this work under the control of the Local Government Board already or hereafter to be created. One reason for this is the fact that municipal loans come under their purview and if this Town Planning Bill is adopted then the authority of the Central Board to approve loans is redundant. The Local Government Board should have no other body to interfere with its operation, for it is conceivable that a Central Board might approve of a scheme and authorize a local board to borrow, whereas the Local Government Board, on whom the final decision would rest, might, in their fuller knowledge of the local circumstances and the state of the money market, refuse to sanction the issue of bonds. Where no Local Government Board is in existence then the Central Board might be free to operate.

The preliminary expenses in preparing any scheme are to be paid out of current revenue or by a special tax to be levied by the municipal council. This is limited to one-fiftieth of one per cent of assessed value of cities under two hundred thousand inhabitants and one-hundredth of one per cent in cases of cities of two hundred thousand and over. It is not clear whether the assessed value is meant to be the net or the gross. Most cities have many properties which are exempt from taxation, but we will assume that it is on the net assessment. In a town where the assessment is one million dollars the expenses will be limited to two hundred dollars, which is insufficient to pay the salary of the Commissioner—let alone make any special investigation. Montreal has an assessed valuation of about $791,000,000. Assuming this is net, then the Montreal local board could spend $79,100. On a similar basis Toronto could spend $51,600, Ottawa $26,000, Guelph, $2,140, Regina, $14,600. It will be interesting to know whether the complete town planning scheme of Ottawa has cost less than $26,000 and of Berlin (Ont.) less than $1,900 and left a surplus ample to pay an adequate salary to the Town Planning Commissioner. The point to be made here is that the development of any town planning scheme is as much a capital charge as the cost of preparing the preliminary plans of water, sewerage, or street railway schemes, or the legal and other expenses in promoting railway or canal schemes, and should be included in the cost. When it has to be paid out of revenue funds then the present ratepayers pay for posterity. The cost of routine administrative work should be paid out of revenue.

With regard to the section dealing with the increased value of property due to the execution of any town planning schemes, which proposes to impose a double tax on the increased valuation of properties improved over ten per cent, and to hand one-half of such extra-taxation to the local board, it is essential to remember that pavements, sewers, and water mains will alone add to the value of property. How is the authority to differentiate between incremental values due to these works and those due to ordinary town planning itself? Moreover, if the municipal authority spends a large sum of money on pavements, sewers, etc., it should derive the benefit of the increased valuation—although it must be borne in mind that the owners have to bear the bulk of the cost as improvement rates. If, however, the local board itself carries out such works the situation may become still more complicated. Assume that a radial or diagonal thoroughfare is laid through a district. It will no doubt improve the value of properties within a considerable range, but the assessor will have some difficulty in placing a differential value and in fixing the limits of the influence of the improvement scheme. It will not be limited to the immediate properties but will be felt for a considerable distance from such radial street. In some cities, increments occur without any appreciable reason. In other cases it will require time to prove the value of any town planning scheme, and therefore some limitations might be fixed as to the period in which increased assessments may occur. Furthermore, in some instances it may need only to change the assessor to obtain a higher assessment. It is evident that some complication will result from dual authorities empowered to carry out works which are intimately related.

Province of Local Board

The local board, according to Section 6 (b) is to be empowered to "carry out any work which it is the duty of any person to execute under the scheme, in any case where it appears that delay would prejudice the efficient operation of the scheme." It will be interesting to know what this means. Supposing a street were to be widened or changed in direction so that a slice or corner of a building had to be cut off. Would it be compulsory on the owner to execute the work? To obtain compensation he must lodge a claim in not less than three months after the publication of the Central Board approval, and if the terms cannot be agreed upon then the matter is to be settled by arbitration or by some other method to be mutually agreed upon.

The local board may find it difficult to finance this scheme, because the acquisition of property after demolition or alteration has often brought about somewhat erratic results. The writer remembers an instance where land measuring about 150 ft. by 20 ft. was required to be taken from the front portion of a churchyard for the purpose of widening an important street. The Council anticipated that the value would be about

$25,000 and as the improvement was urgently needed the amount to be paid was referred to arbitration. The arbitrators awarded $150,000. Take another case. The Metropolitan Water Board, of Boston, who constructed the Massachusetts Dam, employed an appraiser to value the land required for this reservoir. A generous valuation of $697,000 is reputed to have been placed on this land, but the actual cost was $1,182,000 (Report of Special Committee of American Society of Engineers, 1913). Other instances could be quoted, but the above will suffice to show how Boards can be financially embarrassed by unexpected results and thus jeopardize the schemes and afford an abundant crop of criticism.

By all means acquire property, widen streets, construct boulevards and do all that is necessary to improve the town, but it is wise to ascertain the cost first of all. Approval of a scheme will doubtless depend in most cases on the estimated ultimate expenditure of money. Consequential damages are difficult to anticipate.

The writer submits that the ultimate success of any town planning authority will be established more securely and satisfactorily if it be made a part of the municipal council, but always as a separate committee, similar to a Watch Committee, Library Committee, etc., provided that the Central Board be composed of men of experience, tact and energy, possessing the confidence of the public, and therefore removed as far as possible from politics.

In conclusion, the writer desires to express the hope that the good intentions which impelled the Commission of Conservation to draft a measure will continue to prevail. Town planning legislation is needed soon, but it must be effective, adequate and sufficiently elastic to meet various conditions.

The time for actual discussion of the draft act at the Convention was limited and the writer had no opportunity of presenting his views. In the interim he has had more time to digest the proposals, and, feeling that the subject is of sufficient importance, he has written the foregoing observations for the consideration of those whom the subject may concern and interest.

Even if the draft act is immature and inadequate it will do some good in giving many an occasion to think. Whilst some of the observations may appear to be stringent there was no desire to do anything more than present the case impersonally and as definitely as possible.

Town planning is no new study to the writer, as he has written, read and discussed the matter in various phases for the last ten years and has visited many of the places where town planning has been carried out.

R. O. Wynne-Roberts.

Regina, June 24, 1914.

Cost of Constructing and Operating Slow and Rapid Sand Water Filtration Plants

IN a very extensive paper before the recent annual convention of the American Water Works Association Mr. George A. Johnson of New York City discussed present day water filtration practice from all points of view. We here republish from Engineering and Contracting the portion of his paper bearing on the relative cost of slow and rapid sand filtration. Following the excerpt from Mr. Johnson's paper we publish a discussion of the same subject by Mr. John H. Gregory of New York City, which was delivered before the same convention. Mr. Johnson's statement as to cost follows:

Relative Cost of Slow Sand and Rapid Sand Filtration

Construction.—In discussing the cost of building water filtration works of the slow sand and rapid sand types, respectively, consideration will be given only to those items referring to the filter plant proper. Cost of land, pumping machinery, outside connecting piping, intakes, etc., in fact everything outside the filtration plant proper, will not be considered.

For slow sand filter costs the items will include the necessary filter buildings and filters with all appurtenances, all inside piping, sand handling apparatus, preliminary sedimentation basins, preliminary filters and appurtenances and clear water reservoirs.

For rapid sand filter costs the items will include the filter buildings and filters with all appurtenances, all inside piping, filter washing apparatus, coagulating and clear water basins. Thus a fairly good idea may be had of the relative cost of building purification plants of the two types.

It is true that, on account of the much greater area required, the cost for land is far greater in the case of slow sand filtration systems than for rapid sand systems. Roughly, other things being equal, land will cost 20 times as much for a slow sand filter installation as for a rapid sand plant. Furthermore, in large projects, it is often difficult conveniently to locate a site for slow sand filters, while for a rapid sand filter plant it is a relatively easy matter as a rule. If it is necessary to go a long distance in locating an extensive and suitable area of land for a slow sand filter site there is incurred a large expense for a conduit to bring the filtered water to the city. This is very rarely necessary in the case of rapid sand filter projects. So that, in studying the comparative figures which follow, it must distinctly be borne in mind that the costs given for slow sand filter installations are really low, since the important considerations just mentioned are not charged against them.

The figures given in Table I show that the approximate relative cost of building the slow sand and rapid sand filter plants mentioned was $32,600 and $12,100, respectively, per 1,000,000 gals. daily capacity. At 5 per cent the fixed charges on these sums would amount to $4.47 and $1.66, respectively, per 1,000,000 gals. of water filtered.

Operation and Maintenance.—The cost of operation and maintenance of filtration plants in a large measure varies, of course, with the quality of the raw water. In a general way the following examples will serve to show the charges ordinarily made against the operation and maintenance of representative water filter plants in this country.

To summarize, the average cost of building seven of the largest and most modern slow sand filter plants was $32,600 per 1,000,000 gals. daily capacity; and, likewise, the average cost of building six of the largest, and two medium size, rapid sand filtration plants was $12,100 per 1,000,000 gals. daily capacity. The average cost of operation and maintenance varied widely, of course, but averaged $2.86 and $4.04 per 1,000,000 gals. of water filtered by the slow sand and rapid sand systems, respectively. Adding these last figures to the fixed charge on the first cost of construction makes up the following totals:

	Per 1,000,000 gals.
Slow sand filtration	$7.33
Rapid sand filtration	5.70

Discussion by John H. Gregory

Mr. Gregory's discussion of the paper prepared by Mr. Johnson is here given in full:

The author has presented a paper which contains much of interest to water works engineers and superintendents interested in filtration, and there is much in the paper with which the speaker is in hearty accord. There are, however, some phases of the subject on which the speaker holds somewhat different views from those of the author, among which may be mentioned the questions of the cost and difficulty of securing sites for slow sand filters and those of the cost of both slow and rapid sand filters.

Selection and Cost of Site.—The author states: "It is true, on account of the much greater area required, the cost for land is far greater in the case of slow sand filtration systems than for rapid sand systems. Roughly, other things being equal, land will cost 20 times as much for a slow sand filter installation as for a rapid sand plant." There is but little question that, under ordinary conditions, the cost of land for slow sand filters will exceed that for rapid sand filters, owing to the larger area required, but that it will amount to as much as "20 times" that for slow sand filters is open to question. Those who have had experience in acquiring land for water works projects know that, even if only a small piece of land is required on which to locate the works but that this piece of land is a portion of a much larger tract, the purchaser might often as well buy the whole tract of land as to buy only a small portion of it. Thus it may readily be that, in acquiring a site for rapid sand filters, much more land would be actually purchased than needed simply for the plant. It may be that the area required for the construction of a slow sand filter plant will be 20 times that required for a rapid sand filter plant but that the land will cost 20 times as much does not necessarily follow.

In discussing further the question of site the author states: "Furthermore, in large projects, it is often difficult conveniently to locate a site for slow sand filters, while for a rapid sand filter plant it is a relatively easy matter as a rule. If it is necessary to go a long distance in locating an extensive and suitable area of land for a slow sand filter site there is incurred a large expense for a conduit to bring the filtered water to the city." The inference might be drawn from this that it has been exceedingly difficult to secure sites for large slow sand filter plants but the history of many of the plants which have been built will hardly bear out this inference.

In commenting on some of the plants which the author mentions in Table I the speaker might say that he has been personally connected with 7 out of the 15 plants mentioned and is familiar with the reasons which led to the selections of the sites on which these works were built. It is, of course, necessary to have land on which to build filters, whether of the slow or rapid sand type, but in the selection of a site local conditions are often a very important factor.

Table I.—Cost of Construction of Slow Sand and Rapid Sand Water Filtration Plants.

City.	Kind of filters.	Present daily filtering capacity, gals.	Approximate cost per 1,000,000 gals. daily capacity.
Albany, N. Y.	Slow sand	20,000,000	$20,000*
Pittsburgh, Pa.	Slow sand	200,000,000	26,000*
Philadelphia, Pa.:			
Torresdale	Slow sand	260,000,000	37,700*
Upper Roxborough	Slow sand	28,000,000	29,800
Lower Roxborough	Slow sand	17,000,000	26,300*
Belmont	Slow sand	60,000,000	45,200*
Washington, D. C.	Slow sand	100,000,000	30,000†
Cincinnati, Ohio	Rapid sand	112,000,000	11,400‡
Columbus, Ohio	Rapid sand	30,000,000	13,000§
Dallas, Texas	Rapid sand	15,000,000	13,000
Harrisburg, Pa.	Rapid sand	16,000,000	10,300
Little Falls, N. J.	Rapid sand	32,000,000	15,000
Lorain, Ohio	Rapid sand	6,000,000	14,000
New Milford, N. J.	Rapid sand	24,000,000	11,000
Watertown, N. Y.	Rapid sand	8,000,000	11,250
Weighted averages	Slow sand Rapid sand	....	$32,600 12,100

*Cost of preliminary filters included. †Cost of Dalecarlia Reservoir not included. Cost of McMillan Park Reservoir included, and also cost of remodeling Georgetown Reservoir, as well as cost of coagulating basin. ‡Cost of large plain sedimentation basin not included. §Cost of softening works not included.

At Albany, N.Y., for example, practically the first ground available on which filters of either type could be built and which could be purchased at a reasonable price, was that on which the slow sand filters were actually built, just north of the city line. It happened that there was another tract of land a little nearer to the existing water works pumping station, to which the filtered water was to be delivered, where it would have been possible to build either slow or rapid sand filters. To have acquired land there, however, for either type of filters, would have been very expensive. The site on which the filters were built had another advantage in that the intake there would be further away from local sources of pollution. At Albany the Hudson River is tidal. The sewage from the city was and still is discharged into the river without treatment and on flood tides there is often an upstream current which carries some sewage with it. It will be seen then that other factors than simply area of land alone may have a bearing.

At Pittsburgh, Pa., as far as the speaker is aware, no difficulty was found in securing a site for the slow sand filters there, which plant is one of the largest in the world. The filter plant is located directly across the Allegheny River from the Brilliant Pumping Station, from which most of the water used in the city is pumped. It is true that it was necessary to build conduits under the river to bring the filtered water to the pumping station, but the case would have been the same if rapid filters had been built instead, for, if the speaker's memory is correct, the best site on which filters of either type could have been built was that on which the slow sand filters were constructed.

For the four slow sand filter plants in Philadelphia mentioned by the author, namely, Torresdale, Upper Roxborough, Lower Roxborough and Belmont, and of which the speaker had charge of the design, no trouble was experienced in securing suitable sites.

As regards the Lower and Upper Roxborough filter plants, local conditions were of the greatest importance in that it was necessary to utilize existing reservoirs as settling basins, as well as existing pumping stations and pipe lines. Somewhat similar conditions existed with reference to the Belmont plant, although in this

Table II.—Cost of Operation and Maintenance of Slow Sand and Rapid Sand Filtration Plants.

Year.	City.	Kind of filters.	Average volume of water filtered daily. Gals	Cost of operation and maintenance per 1,000,000 gals. of water filtered.
1911	Albany, N. Y.	Slow sand	20,000,000	$2.50
1912	Pittsburgh, Pa.	Slow sand	100,000,000	3.41
1911	Philadelphia, Pa.	Slow sand*	9,000,000	5.62
1911	Philadelphia, Pa.	Slow sand†	13,000,000	3.59
1911	Philadelphia, Pa.	Slow sand‡	38,000,000	3.88
1911	Philadelphia, Pa	Slow sand§	202,000,000	1.91
1912	Washington, D. C.	Slow sand	62,000,000	4.01
1912	Cincinnati, Ohio	Rapid sand	50,000,000	4.12
1911	Harrisburg, Pa.	Rapid sand	9,000,000	3.93
1912	Little Falls, N. J.	Rapid sand	30,000,000	3.20
1912	Louisville, Ky.	Rapid sand	25,000,000	3.48
1912	New Orleans, La.	Rapid sand	16,000,000	6.82
Weighted average		Slow sand Rapid sand	....	$2.86 4.04

*Lower Roxborough. †Upper Roxborough; ‡Belmont. §Torresdale.

case there was no reservoir which could be utilized as a settling basin.

The Torresdale slow sand filter plant is the largest single plant in the world, and if difficulty had been experienced in securing suitable sites for such works it would naturally be expected to have occurred here. Such was not the case, however, and the plant was built inside the city limits. It is true that the plant was located some distance upstream from the closely built-up part of the city, and that a conduit about 2½ miles in length was constructed through which filtered water is delivered to the Lardner's Point pumping station, but it was good judgment on the part of the city authorities to locate the works where they did.

The Delaware River at Philadelphia is tidal and is polluted by the discharge of sewage from the city, and it was to avoid pollution as well as to secure a site that the plant was built as far upstream as it was. It might be added further that the city has already constructed a small sewage disposal works just below the Torresdale filter plant (the Pennypack Creek works), where sewage is treated and the effluent disinfected before discharge into the river, in order to guard against raw sewage from the nearest point from reaching the intake of the Torresdale filters. Had rapid sand instead of slow sand filters been built at Torresdale there is no question in the speaker's mind but that such a plant would have been built as far upstream as were the slow sand filters.

One might fancy, possibly, that trouble would be experienced by the city of New York in securing sites for filters. Such is not the case. Over ten years ago the Commission on Additional Water Supply, in its investigations for an additional water supply for New York City, looked into the question of filter sites not only for the additional supply but also for the Croton supply. Sites were found where slow sand filters could be built in close proximity to the existing Croton Aqueduct, and sites for slow sand filters were also found and surveyed where the additional supply could be filtered along the line of the proposed new aqueduct. Some years later the Department of Water Supply actually prepared detailed plans for a slow sand filter plant for the Croton supply, on a site located in New York City, namely, in the east basin of Jerome Park Reservoir, the construction of which was suspended pending a decision as to the filtering of the supply. In the case of New York City it is not a question of going a long distance and building an expensive conduit to get a filter site, but rather a question of going a long distance and building an expensive conduit to get water.

The Cincinnati Plant

At Cincinnati, Ohio, the rapid sand filter plant, which is the largest of its kind in operation in the world, was built well upstream above the city where plenty of land was available for either rapid or slow sand filters. The filtered water is discharged through a long conduit to the main pumping station from which it is pumped to the reservoirs in Eden Park. This plant was built for the future as well as for the present and it was good judgment to locate the plant as far upstream as it was.

At Columbus, Ohio, the rapid sand filters were built at some little distance upstream above the city. It was a case here of going upstream to get out of the flood zone, although sufficient land for either rapid or slow sand filters was available nearer the city. At the point where the plant was finally built there was sufficient land for either rapid or slow sand filters. In acquiring the land for this particular plant it was found that it would be about as cheap to acquire the whole tract of land on which the works were built as to acquire only so much of the same as would be needed for the plant alone.

Perhaps enough has been said to point out that factors other than the area of land alone have to be taken into account, not only for slow but for rapid sand filters as well, in selecting a suitable site.

Cost of Construction.—The author also considers, in Table I, the cost of construction of different types of filters. It is exceedingly difficult to compare satisfactorily the costs of construction of different plants, even where the fullest information regarding the same is available. Those who are not well posted as to the history of some of the plants cited in the table may possibly be misled as to the cost of building both slow and rapid sand filters if they accept the figures of the author without full knowledge of local conditions.

One of the features which very materially affects the cost of such works is the total reservoir capacity provided, that is, the combined capacity of the settling basins are of the clear water reservoirs. To illustrate: The rapid sand filter plant at Little Falls, N.J., which, in the author's table is the most expensive one cited, and which cost $15,000 per 1,000,000 gal. daily capacity, has a coagulating basin capacity of 1.3 hours and a filtered water reservoir capacity of 2.6 hours, or 3.9 hours total reservoir capacity. At Columbus, Ohio, the rapid sand filter plant there, which the author states cost $13,000 per 1,000,000 gals. daily capacity, the next to the highest in cost cited, has a settling basin capacity of 12 hours and a filtered water reservoir capacity of 8 hours, making a total reservoir capacity of 20 hours, or five times as much reservoir capacity as that of the Little Falls plant. If the reservoir capacity of the Little Falls plant had been approximately that of the Columbus plant the cost of construction of the Little Falls plant would have been materially increased over that given by the author. Again, the New Orleans rapid sand filter plant might be cited, which has 35.2 hours total reservoir capacity, or practically nine times as much reservoir capacity as that of the Little Falls. Other factors which affect the cost of construction are the character of the raw water, the rate of filtration, the character of the construction of the works, etc.

In his reference to the Albany slow sand filter plant the author gives its capacity as 20,000,000 gals. daily. The Albany plant as originally built before the pre-filters were added had a capacity of 15,000,000 gals. daily. The addition of the pre-filters increased the capacity of the plant very materially so that at the present time the capacity is probably in the neighborhood of 28,000,000 gals. daily. If the capacity is taken at 28,000,000 instead of 20,000,000 gals. daily the cost of the plant would be about $14,300 instead of $20,000 per 1,000,000 gals. daily capacity as given by the author.

The Philadelphia slow sand filter plants were expensive plants to build. They differ in one way from many of the other filters of the same type that have been built in that underneath the filter floors and carried up all around the side of the filter is a layer of puddle. This item alone materially increased the cost of construction.

In the cost of the Lower Roxborough plant the author did not include the cost of the Lower Roxborough Reservoir which was built many years before, and which supplies settled water to the filter plant. Again, a similar condition exists at the Upper Roxborough filter plant with regard to the settling basin. The New Roxborough Reservoir was built some ten years earlier than the filter plant, and the author has not included its cost in the cost of the filter plant. Strictly speaking, the costs of the reservoir should be included in the costs of these two plants so that the figures would be comparable with the costs of the other slow sand filters cited.

The Philadelphia plants were built during a period of very high prices, and to use the costs of construction of these plants to indicate the reasonable cost of slow sand filters may be very misleading except to those who are familiar with the early history of these works and who are aware that the costs were high and that the plants could be duplicated at less cost.

Montreal and Toronto Plants

The largest slow sand filter plant under construction in America at the present time is at Montreal, and, when completed next year, will have a capacity of 60,000,000 U. S. gals. daily capacity. The total cost of the plant, on the basis of the lump sum contract prices, including the low lift pumping station, will be about $22,600 per 1,000,000 gals. daily capacity. Deducting the low lift pumping station the cost will probably be about $21,000 per 1,000,000 gals. daily capacity.

It would have been interesting if the author had cited the cost of the slow sand filter plant which was completed at Toronto about two years ago. This plant has a capacity of 48,000,000 U. S. gals. daily, assuming one-sixth of the filter area to be held in reserve, and based on a rate of filtration of 6,000,000 U. S. gals. per acre daily, the rate for which the plant was designed. The cost of the plant, omitting the low lift pumping station, was only about $12,700 per 1,000,000 gals. daily capacity.

In considering the weighted average cost of slow sand filters given by the author, namely, $32,600 per 1,000,000 gals. daily capacity, it may be well to bear in mind that the Montreal plant will cost only about $21,000, that the Albany plant cost about $14,300, and the Toronto plant only $12,700 per 1,000,000 gals. daily capacity.

In referring to the cost of rapid sand filter plants the author cites the Columbus plant as costing $13,000 per 1,000,000 gals. daily capacity. This plant was designed and built under the speaker's direction and is a water-softening as well as a rapid sand filter plant. The speaker is not informed as to what items the author included in arriving at the cost of the Columbus plant, but in the speaker's judgment the Columbus plant, considered as a rapid sand filter plant alone, cost nearer $15,000 than $13,000 per 1,000,000 gals. daily capacity, the figure given by the author.

Another rapid sand filter plant which the author might have cited is that at Toledo, Ohio. Part of the plant was built for a capacity of 60,000,000 gals. daily, although the present capacity of the works is considerably less. Including only such items as are chargeable to the filter plant proper the works cost about $14,500 per 1,000,000 gals. daily capacity.

Another rapid sand filter plant which might have been cited is that at Grand Rapids, Mich. The plant was completed inside of the last two years and has a capacity of 20,000,000 gals. daily. The cost of the plant, as given to the speaker by the Grand Rapids officials last year, including such items as are chargeable to the filter plant proper, was $16,300 per 1,000,000 gals. daily capacity.

In December, 1912, the city of New York received bids for a rapid sand filter plant to be located at Jerome Park Reservoir and having a capacity of 320,000,000 gals. daily. The speaker is more or less familiar with the plans for the proposed Jerome Park filters as he served as one of a Commission of Engineers appointed by the Board of Estimate of New York to report on the same. Taking the lowest bid received and adding to it the cost of the buildings and other necessary work, the Jerome Park filter plant, which would have been the largest rapid sand filter plant in the world, would have cost about $18,400 per 1,000,000 gals. daily capacity. When the plant is built, and it is greatly to be hoped it will be built soon, the actual cost will probably be in the neighborhood of $20,000 per 1,000,000 gals· daily capacity, as much of the excavation for the plant has already been completed.

The author gives the cost of the Cincinnati rapid sand filter plant, which has a daily capacity of 112,000,000 gals., as $11,400 per 1,000,000 gals. daily capacity, and states that the cost of the large, plain sedimentation basins is not included. At Cincinnati there are two large settling basins to which the raw water from the Ohio River is pumped. The water is first settled in these two basins at the filter plant. There is no question in the speaker's mind but that the settling basins are part of the filter plant at Cincinnati, but just how much of the cost of the same should be chargeable to the filter plant may be a question. Mr. J. W. Ellms, the superintendent in charge of the filters at Cincinnati, in a paper printed in the Journal of the Association of Engineering Societies in January, 1912, states:

> The settling reservoirs, which have a capacity of 330,000,000 gals. of available water, are in part a portion of the water purification plant, although they also serve the purpose of storage basins and were designed for such a use quite as much as they were for sedimentation purposes.

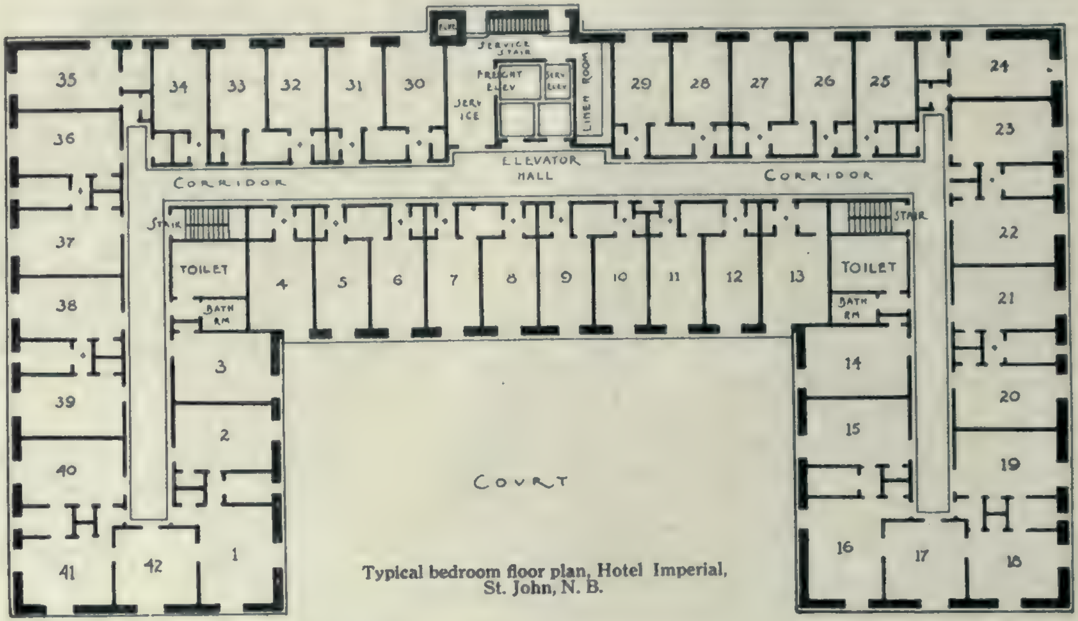
The two settling basins cost $1,521,000, or about $13,600 per 1,000,000 gals. daily capacity of filter plant. Adding this cost to that of the filter plant would give a total cost of $25,000 per 1,000,000 gals. daily capacity. As the settling basins serve as storage reservoirs also it may be reasonable to charge the filter plant with perhaps only half their cost. On this assumption the cost of the settling reservoirs chargeable to the filter plant would be $6,800 per 1,000,000 gals. daily capacity, thus making the total cost of the filter plant $18,200 per 1,000,000 gals. daily capacity.

The New Orleans Plant

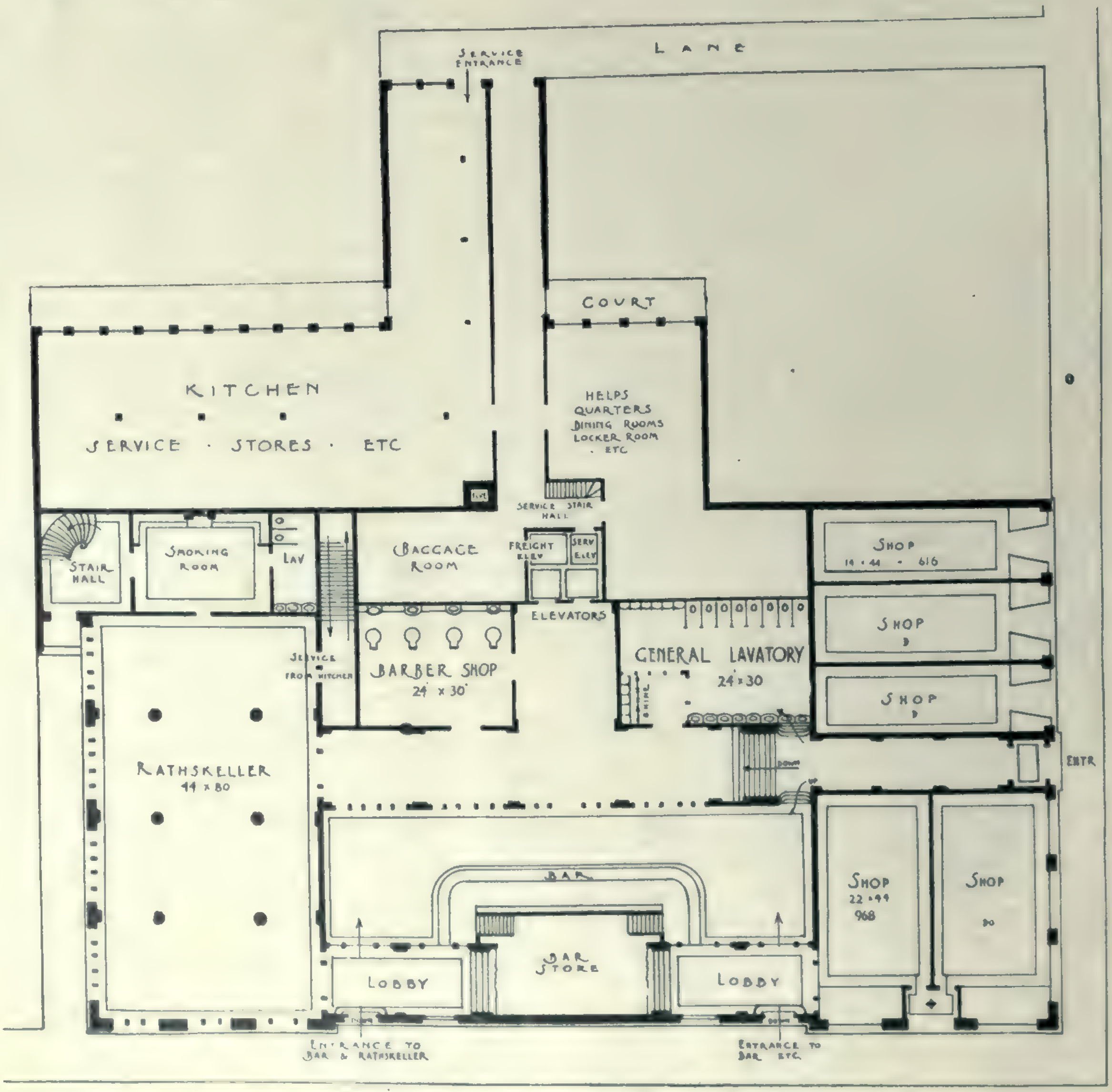
Still another plant which the author might have cited, and among the best in the country, is that at New Orleans, which has a capacity of 40,000,000 gals. daily. Including only such items as are chargeable to the filter plant proper the cost of the New Orleans plant was about $30,200 per 1,000,000 gals. daily capacity.

The weighted average cost of the Columbus, Toledo, Grand Rapids, Cincinnati and New Orleans rapid sand filter plants is $18,600 per 1,000,000 gals. daily capacity, while the author gives a weighted average cost for rapid sand filters at $12,100. In other words, the weighted average cost of the five plants just cited, all of which are in operation and which are among the best in the country, is over 50 per cent higher than the weighted average cost given by the author.

The speaker has but little further to say on the subject of costs except that, in his judgment, the weighted average costs as given by the author are too high for slow sand filters and are too low for rapid sand filters.



Typical bedroom floor plan, Hotel Imperial, St. John, N. B.



Ground floor plan, Hotel Imperial, St. John, N. B.

Similarly the fixed charges on the costs of construction would respectively be too high for slow sand and too low for rapid sand filters.

The speaker is not presenting any brief for slow sand filters. The rapid sand filter is more flexible than the slow sand filter and in the majority of cases in the United States is better adapted to the purification of water than is the slow sand filter. The slow sand filter has done and is still doing good work in this country, and the present status of water purification is, to a large extent, due to the introduction of the slow sand filter.

Splendid New Hotel Planned for St. John, N. B.

Messrs. Ross and Macdonald, of Montreal, have drawn plans for a proposed hotel at St. John, N.B., to be known as the Hotel Imperial, for the Hotel Company of St. John, Limited. The building will be erected on the north corner of King Square and Sydney Street, with a frontage of 184 feet on King Square. It will be six storeys high, the plans providing accommodation for 200 rooms, 125 of which will have private baths. The plans also provide for a large public dining room, private dining room, restaurant, banquet and dancing hall, large rotunda, writing rooms, ladies' parlors, tea room, bar room, gentlemen's cafe adjoining, and barber shop. The restaurant will have a seating capacity of about 300. The plans have been so drawn as to allow shops on the ground floor facing on King Square and others facing on Sydney Street. The building will be absolutely fireproof. The equipment includes a cold storage plant for the kitchen and bar.

Proposed Hotel Imperial, St. John, N. B.

Including land and interest charges, the building is estimated to cost $760,000, while the furnishings will involve an expenditure of an additional $125,000. The frame of the building will be of steel, with reinforced concrete floors. The exterior is to be of Indiana limestone and clay brick, with a roof of copper. Several elevators will be installed.

Across the border, the use of hollow tile as a structural building material has been given a great impetus by the recognition by the United States Government of this type of construction. Notable instances of this fact may be found in the new Post Office building to be erected at Grass Valley, California, and in a new dormitory building to be erected for the Phoenix Industrial school for Indians at Phoenix, Arizona. In both of these cases, hollow tile are specified for the construction of exterior load bearing walls.

Extensive Buildings for the Canadian Kodak Company, Limited, Toronto

Excavation is in progress on the site for the erection of an extensive range of buildings for the Canadian Kodak Company, Limited, Toronto. The new plant will consist of seven buildings with a floor area of more than 480,000 square feet. The largest building will be 460 feet long by 80 feet wide, and five storeys high. When completed the plant will be one of the largest manufacturing establishments in Canada. It will be located at Mount Dennis, an imposing site situated about a mile beyond the city limits and will involve an outlay of about $1,250,000. It is anticipated that the new plant will be ready for occupation in about two years. On completion it is the intention of the company to transfer the entire industry at present located in three buildings on King Street west, to the new plant. The plans call for reinforced concrete construction, with metal sashes glazed with wire glass. Some idea of the size of the structure will be gathered from the fact that 2,500 tons of steel bars, 600 tons of fabricated structural steel, 80,000 square feet of metal sash and 25,000 cu. yds. of concrete involving the consumption of 45,000 barrels of cement, will be used. All stairways will be of the Philadelphia type, enclosed in stair wells so that they open into exterior balconies. In case of fire employees will thus be outside the fire zone as soon as they reach the stair wells.

For fire protection a complete system will be installed, consisting of outside hydrants, hose houses, and a sprinkler system for each building. Fire mains and sprinkler will be fed by a fire pump having a capacity of 1,000 gallons a minute, which will be installed in the power house and connected with a concrete reservoir. A reservoir supply of water will be stored in tanks 30 feet above two of the buildings, each of the tanks having a capacity of 50,000 gallons. The water for manufacturing purposes will be drawn from two concrete reservoirs the capacity of which will be one million gallons. The buildings have been especially designed for the manufacture of kodaks, cameras and other products of the Kodak company. As Kodak Heights is about a mile beyond the city limits the water supply will be drawn from wells of 150 ft. in depth, located on the company's property. These wells have a combined flow of about 175,000 gallons a day. The manufacturing buildings proper will be located on a plateau at the foot of which the power plant will be erected. This latter is designed to accommodate boilers of 3,000 h.p. and there will be an immediate installation of 1,500 h.p. Electrical energy will be supplied by three steam-driven generators, with a capacity of 1.000 h.p. An important feature of the power plant will be a chimney 200 ft. high and 9 ft. in diameter at the top. To meet the requirements for the manufacture of sensitized material there will be a battery of three ice machines with a capacity equal to the melting of five hundred tons of ice in twenty-four hours. Rest rooms and dining rooms will be provided for employees and everything in connection with the enterprise will be carried out on the most modern lines. The buildings were designed by Mr. C. K. Flint, architect, Toronto. The general contractors are Messrs. C. E. Deakin, Limited, of Montreal.

Reinforced Concrete in Theory and Practice* (Conclusion)

By Alexander Melville, C. E.

A good contractor, having secured a contract, studies the plans thoroughly to consider how he can do the work most expeditiously and economically.

The first point he must decide is the lay-out of the job—where his plant is to be placed, whether his steel is to be assembled on the job or in his yard, whether to use hoists, cranes, or a movable mixer and spout.

His next consideration will be the arranging of a staff. This, of course, will depend on the nature and size of the work. If the job is of considerable size he will have a resident manager, directly responsible to his office for the carrying out of the work.

Directly in touch with the manager will be those in charge of the various departments of the work—carpenter foreman, steelwork foreman, concretor foreman, excavator foreman, timekeeper, and book-keeper. In touch with these head foremen will be sub-foremen, or gangers, over each squad.

Having settled his staff, the question arises how the work is to be carried out—every part to be tackled at once or in sections, and which section first—with a view to continuous employment of a full staff of men throughout. This is often one of the most difficult parts to manage.

Take the case of a building of two wings and a cross building—a U on plan. A good method to adopt in this case would be to make a start on one wing first, and then put the joiners on to the other while the steel is being laid and concreted in at the first wing. It would not be difficult, if this method of working the various trades on alternate wings can be carried out, to carry on the work at full bore throughout. This is, of course, a simple case; others I have come across are very difficult to plan.

If work is carried on in a spasmodic fashion, as in the instance already taken, if both wings were carried on simultaneously with the same trade, a contractor will never make a satisfactory job. He would continually be taking on complete gangs, and would thus find it difficult to get a good set of men. Work would be slow, and, being carried out by casual labour, not of first-class order.

Methods of Timbering

Having made all preliminary arrangements, the contractor must consider the method of timbering to be employed. If he is wise, he will send a typical drawing to the job, showing generally how the foreman is to plan his work. This typical drawing is usually sufficient, and an efficient foreman will adopt the method shown to all details of the work.

In fixing on a method, the two main points for consideration are "ease in striking and adaptability to alteration." Such a thing as a wall form need only be considered from a point of view of ease in handling and strength for continual re-use.

But in the case of column casings, one must consider as well as the foregoing, adaptibility to alteration. The columns on the second storey of a building are invariably of smaller cross sectional area than those immediately below them, so that if the casings are to be used over again they must be built with a view to saving as much labour as possible in alteration.

We find the same problem in beams and in floor slabs due to alteration in beams, but not to the same extent as we come across in columns.

When a floor is concreted the order in striking is columns, beam sides and floor slabs, the underside of beams being left until long after the rest has been cleaned away.

This is the order that must be considered when one is planning the timbering, unless he is prepared to use the job as a timber store. When a floor is struck for the purpose of using the timber above there are no struts left but those under the beams. It is therefore inadvisable when timbering for the next floor to place struts anywhere but above the beams, the concrete in the floor slab being too green to take much load. Thus it becomes advisable to support all the timbering on struts above the beams, and this is the method of support almost universally employed. As a rule, a cross-head is placed on the top of the strut, and on this the beam side forms rest. Among the side of the forms a runner is fastened, and on this runner rests the joists for the floor slabs. It is thus possible to strike everything else without disturbing the struts and timbering of the underside of the beams. Unless great care is taken, considerable damage is done to the timbering—particularly that for the floor slabs—when striking.

A method sometimes employed in America, but which I have never seen here, is to use a double-horse for lowering forms. This consists of a light movable framework not unlike an inverted four-legged table. These legs reach close to the ceiling, and between each end pair is stretched a rope into which the timber is placed. The ropes run through pulleys, and are then passed down, and the forms are lowered with motherly care.

I have found quite a successful method is to make our struts built, composed of No. 2, 6-in. by 2½-in., with 2½-in. distance pieces every 4 ft. or so apart. When striking, a handy scaffold can be formed by placing runners through the struts, supporting adjoining beams and resting on the distance pieces. On planks placed in these runners the men striking can work and hand the forms down carefully.

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*Continued from last issue.

Timbering is a very heavy item in reinforced concrete work and on which is a considerable drain on a contractor's resources, as it has to be used over and over until it is scrap before he gets a full return for his expenditure. When their accounts are due, timber merchants will not be put off the way contractors are by quantity surveyors. A contractor naturally tries to save as much in his timbering as possible. Some try to save by using material of small scantling, but this is false economy. There is relatively more value to be got out of material of stouter section, particularly with boards. A standard thickness for these should be 1½-in.; anything less is liable to much damage in striking. Beam bottoms particularly should be 2-in.

Efficient Handling of Steelwork

A contractor had also to consider handling steelwork in the most efficient and least costly way. Let us hope, for the sake of his finances, that he has not estimated on the figure specialists inform us the labour cost is. For ease in working the steel should be laid out in separate stacks of the various scantlings, and, where possible, in separate stacks of the various lengths as well. The workers can then find any bar that is required immediately. This takes some labour on the arrival of material, but it pays.

Before it is placed on the forms, all the steel has to be bent to some shape or form, and this is most conveniently executed without the use of any power-driven machine. There are many useful hand machines on the market, such as the "Kenendy," but all I have come across are slow when dealing with large sections. For bars of 1-in. diameter and down they are handy and make a good job. Above that they are usually worked by means of a ratchet, which is slow work; or, if not, the stain is such that some part is apt to give way. A stoppage is an expensive matter, and one cannot always keep a complete stock of spare parts. I find the simplest and most effective method of dealing with all sizes except the highest is by employing tubes with strong ferrules at the ends. One merely slips the tubes over the rods so that the end coincides with the position of the bend, and pulls the other end round to the required angle. Those tubes are of varying lengths and strength, depending on the diameter of the bars to be bent, but a handy length for bars up to 1¼-in. diameter is 6 ft. They are not expensive, and a stock can be kept. Their fault is that they tend to burst at the ends, so it is wise to have long strong ferrules, screwed or shrunk on. For bending stirrups a small tube 18-in. long may be used, as already described, or, what is probably the most handy, a steel claw. This claw is like a two-pronged fork, the prongs being shaped on side view like a mark of interrogation.

When the steel is bent and the stirrups made, say, for a beam, the various parts have now to be assembled. This is best done on trestles so that men may work all round it with ease. The beam being built, it is placed in position on the shuttering already prepared for its reception. It is necessary to keep the steel from resting on the boards when concreting, and a convenient method of doing this is placing little wedge-shaped pieces of concrete on the forms to begin with, and then resting the steel on these. These blocks are made of rich concrete in moulds and in lengths corresponding to the widths of the beams in which they are to be placed. In section they are about ¾-in. deep, and varying in width from 1½ at the top to 1-in. at the bottom. Being of concrete, they are not removed, but are concreted in, and, being wedge-shaped in section, there is no fear of them falling out on removal of the centering. When the steel is all placed in position the next process is concreting.

The mixing of the concrete should be by a mechanical mixer of the batch type, which gives the most satisfactory results. From a contractor's point of view also it is the most economical, and allows of much more speed in working than mixing by hand. From the mixer the concrete must be conveyed rapidly to where it is to be deposited, and this may be done by barrows and hoists, cranes and skips, or lifting buckets direct from the mixer, depositing into a bin at the level required or into the funnel of a spout. The mixer has its merits depending on the nature of the particular job, the main thing being to deposit it rapidly and without dropping from a height.

The concrete must be well tamped in position and carefully worked round the rods so that it will adhere everywhere. Most tampers in the market, I find, are just too heavy for general work, and tend to tire the men and induce them to scamp the tamping whenever they are not watched. It is quite possible to make a good job with a light tamper if used well, as with a heavy one. For beams I find the best type of tamper to be a ½-in rod bent at about 2-in. from the bottom at right angles and slightly feathered. With this the concrete can be well worked round stirrups and rods. To make a good face on walls of beam sides there is nothing better than a shovel worked up and down against the shuttering. For floor slabs a ½-in. plate, 6-in. by 6-in., rivetted to the end of a handle answers well. Another good method is to use a wooden roller, which has this advantage—that it is not so apt to jar the work by causing vibration in the forms.

When filling columns and walls it is desirable to hammer the form with wooden mallets. This aids in giving a dense concrete and helps to make a smooth finish. In concreting floor slabs and beams it is well to start at the farthest point from the hoist when it is being deposited from barrows, so that no wheeling will be done over green concrete. It is advisable also to have an experienced man stationed underneath to watch for any deflections, so that work can be stopped at once and extra staying or wedging executed before initial set takes place.

In few jobs is it possible to finish a floor throughout in one day, so the question arises how and where to make a stop. These should be made as near as possible to the centre of the span, and the stop should be made vertical against a board placed on edge for the purpose. When starting next day this joint must be thoroughly wetted and brushed before depositing fresh concrete, and in some cases coated with a rich mortar, or, if necessary, the face roughened.

Before depositing any concrete the forms should be well watered, and, of course, it is necessary also on deposited concrete, for about a week after laying. It makes a sounder concrete and prevents cracks due to quick drying.

Where a floor is finished, and joiners have erected the cases for the columns above, and more so when columns and walls have been concreted and joiners start to lay the boarding for the floors, shavings and sawdust accumulate on the top of the concrete of columns and walls. No temporary handy covering I know of will keep the concrete free from this. The best method to get rid of it before concreting is started, and it must be got rid of, is to form traps in the column cases and the wall shuttering at the level at which the concrete was stopped. The concrete surface is then swilled with water, and the shavings float off through the traps or doors. If plenty of water is used, a thoroughly clean surface can be obtained on which to start depositing the fresh concrete. It is, of course, advisable to see that the gang is not too quick.

I have now covered a fairly large field in reinforced concrete work, and tried to express how it strikes a contractor who has been in the midst of its troubles for a considerable number of years.

Economical Proportioning of Concrete

ECONOMICAL proportioning of concrete does not always consist in using the leanest possible mixture, writes Sanford E. Thompson, Consulting Engineer. If the quantity to be laid is small, it is sometimes cheaper to use materials at hand, selecting the proportions arbitrarily and adding an excess of cement to insure the required strength and water-tightness, rather than to make the tests required for the more scientifically proportioned mixture. On the other hand, upon large or important work it pays from the standpoint of dollars and cents to make thorough studies of the aggregates, carefully grading the materials so as to use the smallest possible quantity of cement, which is always the most expensive ingredient. This fact has been seriously overlooked in the past, and thousands of dollars sometimes have been wasted on single jobs by neglecting laboratory tests and studies or by errors in theory. By adjusting the proportions of the aggregates instead of selecting them arbitrarily, a concrete of equal density, strength and water-tightness may be made almost always with the use of less cement. On a certain job, for example, where water-tight concrete was required, a net saving was effected of 74 cents per cubic yard by carefully grading the materials, the resulting concrete being as watertight as the richer mixture, having proportions selected by judgment.

Reinforced Concrete Bridge at Toronto

THE city council of Toronto has let the contract for the construction of a reinforced concrete bridge on Crawford street over Bellwoods Park, Toronto, to Messrs. Wilson, Townsend & Saunders, engineers and contractors, Toronto. The bridge will consist of three arch spans, one of 90 ft. and two of 63 ft., with concrete approach arches. There will be a 21-ft. roadway and two 6-ft. cantilever sidewalks. For the arch ribs welded structural steel reinforcement will be used, and cold twisted steel for the other portions of the structure. The piers will be constructed of 1:3:5 concrete. A 1:2:4 mix will be used for the main arches, deck arches, floor system and for the floor and sidewalk slabs, except the surface veneer layer of the latter. For the sidewalk balustrade the mix will consist of one part cement and four and one-half parts crushed granite. The pier excavations—except in the case of two piers in the approaches, which will be supported on piles—will be taken down to bed rock or to such depths as may be necessary to secure a good foundation. The borings at the location of the work show rock at a depth of 20 ft. to 34 ft. The main arches will be constructed in transverse sections beginning at the spring lines of each, and from both ends of opposite arches simultaneously. To ensure symmetrical loading the deck arches and floor system of the spans will in each case be constructed from opposite ends of spans at the same time. All surfaces exposed to the view will be finished by rubbing with sandstone or carborandum brick, after which a cement grout wash will be rubbed in. Other face surfaces exposed to direct weather conditions will be rubbed and a final finish of wet cement grout will be applied with a brush. The construction will be followed as far as possible in the following order: middle arch piers, end arch piers, approach piers, arch rings, approach arches and abutments, deck arches and stringers for all three spans floor slabs and sidewalk construction. The work will involve an outlay of about $45,000, and operations will be started without delay.

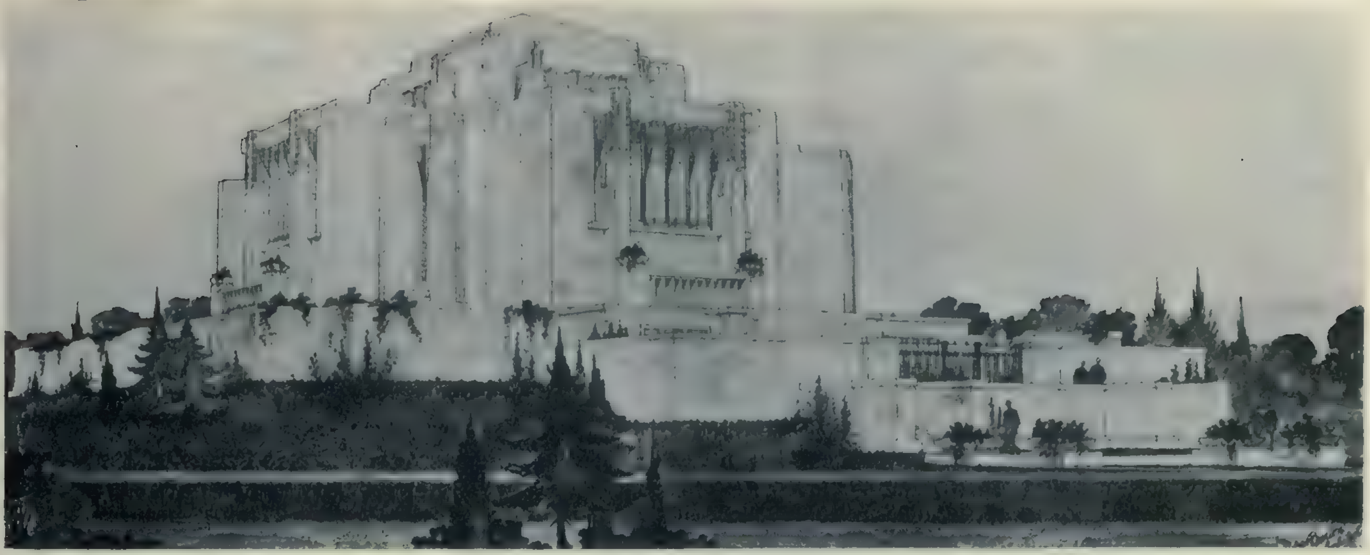
How to Patch a Concrete Floor

WHEN a cement floor surface begins to wear it is often desirable to patch it. Leonard C. Wason, president of the Aberthaw Construction Company, Boston, in a recent paper, states the right way and the wrong way.

The Wrong Way.—Commonly a sand and cement mortar is made, some cutting is done and the mortar is put in and scrubbed with a steel trowel until smooth. It is then covered up for a while. If the concrete under the patch is left dry, it soaks up the water of the mortar. As a result, the mortar does not set. If the room is dry or hot the surface of the patch dries out and for the same reason it does not set. If the concrete under the patch is dusty the patch does not adhere to the concrete. If the materials in the mortar are not suitable, naturally the patch wears badly, particularly as it is obviously located at a point of severe wear.

The Right Way.—Cut down the worn place at least one and a half inches. This cutting should be carried into the strong unbroken concrete and the edges should be cleanly undercut. The bottom of the cut should then be swept out, clean-blown out with compressed air or a pair of bellows, if available, then thoroughly wet and scrubbed with a broom. In this way, small loose particles of broken material which the chisel has driven into the surface are removed. A grout made of pure cement and water about the consistency of thin cream, should be scrubbed into the pores with a broom or brush, both at the bottom and sides of the cut. Following this a stiffer grout, about the consistency of soft putty, should be thoroughly compressed and worked into the surface, which has already been spread with grout. Finally, before the grout is set a mortar made of one part cement to one part crushed stone or gravel, consisting of graded sizes from ½ inch down to the smallest excluding dust, should be thoroughly mixed and put in place, then floated to a proper surface. Cover with wet bagging, wet sand, sawdust, or other available material. All trucking should be kept off and the surface kept thoroughly wet for at least one week or ten days.

If a particularly hard surface is required, 6-penny nails are sometimes mixed with the mortar and other nails stuck into the surface when the patch is finished. This will produce a surface which is extremely hard and durable.



Alberta's Proposed Mormon Temple

REPRODUCED herewith is the architects' perspective of the proposed Temple which is to be erected at Cardston, Alta., for the Mormon Church at an estimated cost of $300,000. The foundation work is now practically completed. The building will be of permanent construction in every detail and reinforced concrete with Kootenay stone will be employed largely. The architects, to whom we are indebted for the accompanying view, are Messrs. Pope & Burton, Salt Lake City, and the Superintendent of Construction is Mr. H. A. Christenson, of Calgary. The contractors for the masonry work are the Kootenay Gravel & Monumental Works, Nelson, B.C.

The World's Heaviest Office Building

THE Equitable building, now under construction in New York City, from its great area presents an interesting problem in heavy erection. It will be the heaviest office building in the world when finished. The steel erection was made especially difficult by extensive cross-lot timber bracing, which holds the basement retaining wall until sufficient steelwork has been installed to take the load. It was necessary to set the derricks and with them erect the steelwork for the three storeys below ground, all without damage to the cross-lot bracing.

The new building will be about 160 x 312 feet in plan and about 500 feet above the street and 65 feet below at lowest point. It is considered a 36-storey building, but there will be intermediate floors at the third and thirty-fourth floor levels, making thirty-eight floor levels.

The elevators, stairways, lavatories, smoke-stack, etc., will be placed in the centre or core of the building. All offices will have an exterior exposure.

The steelwork was erected to the second floor by six steel guy derricks, with 76-foot masts and 65-foot booms. The heaviest column weighed 32 tons. Above the second floor the heaviest piece to be handled weighs about 16 tons, and 15-ton derricks with 90-foot masts and 85-foot booms replaced the original six. The longer reach of these lighter derricks rendered them much more useful in handling material from the street.

After the steelwork west of wall columns 7 and 125 was erected, derricks proceeded to erect the basement steelwork eastward, moving forward along the basement steel, erecting steelwork ahead, similar to the moving of a traveller. In this way, liability of accident to the cross-lot bracing was reduced, and the expense of building bents for supporting the derricks was eliminated.

The total steel aggregates 33,000 tons. It is shipped to Greenville, N.J., lightered over to New York City in the vicinity of the Battery, and trucked to the job. Each derrick handles the steel from the street for its particular section.

Crushing Brick for Concrete

Crushing old brick for concrete used in fireproofing the new city hall in San Francisco has been under way for some time, and the method is reported to give satisfactory results at a low cost. The brick encumbered the site of the old city hall, where great quantities of them have lain since the wreck of that structure in 1906. In preparing the site as part of the new civic center the removal of the brick debris was quite an item, and it was finally decided to make some use of them in the civic buildings. Accordingly, a gyratory rock crusher was installed, which receives brick and the adhering mortar in chunks, just as taken from the ruins and reduces them to 1½-in. size or less. From the crusher, to which wagons dump directly, the material falls upon a bucket conveyor that elevates it to a bin, which in turn feeds by gravity into the wagons. No screens are used, and no trouble has been experienced from excessive lime or brick dust content. The ground brick are used in place of rock in 1:2:4 or even 1:3:6 mixes, the concrete being used only for fireproofing, in slabs, etc. It is interesting to note that legal action against the city for patent infringement has been taken by a company owning patents on a process for fireproofing steel structures by the use of burned clay mixed with concrete.

Ontario Commissioners' Valuable Report on Highway Administration

THE activities of the Public Roads and Highways Commission of Ontario are reflected in an instructive and voluminous report which has just been submitted to the Lieutenant-Governor in Council.

In the first place the Commission presents its Findings and Recommendations. The more noteworthy of these, as summarized in the report, are given below.

The Appendices, which comprise some two hundred pages of material, accompanied by illustrations, maps and plans, embrace every conceivable phase of the subject and matters correlative. The importance of developing the agricultural interests is considered carefully, emphasis being laid upon the desirability of a governmental policy of striving to increase the agricultural and mineral output of the country. A close view is taken of the relation between the city and the farmer, the purpose being to show the vital importance of an agressive road policy—and the facts and figures adduced accomplish this end. The municipal and other resolutions presented to the Commission, together with a summary of evidence, are placed on record in the report. Following this section are road mileage and traffic census tables.

Concrete road construction at Sarnia, Ontario.

An analysis of automobile registration in the province of Ontario is interesting by virtue of its completeness, every detail being given and comparisons made with the status of United States cities and states.

Perhaps the most valuable of the Appendices is one which comprises a compendium of highway organization in Canada and the United States. A summary of the information relating to the various provinces of the Dominion is presented herewith, after the Findings of the Commission. The particulars of highway improvement in the United States relate to Massachusetts, New York, Pennsylvania, Ohio, Michigan, Minnesota, Wisconsin and California, and comprise details of area, population, wealth, taxation and general expenditure, with concise statements showing the progress of state highway work, the line along which development has proceeded, and the cost of construction and maintenance. This is a particularly valuable feature—one which those identified with highway administration will find repay careful study.

A historical sketch of road development in Ontario outlines the policy of public works followed by the province during the last century and is illuminating as to the strides that are being made in the present day. The remaining appendices comprise: Township Roads—Statute Labor and Expenditure; Road Improvement and Land Values; Memorandum on Assessment in Ontario; Data for Chart of Farm Production; Toll Roads; Note on Report on Location of Road Material; Urban Municipalities of Ontario; arranged in order of Density of Population; Township Road Expenditure, 1900, 1905, 1910.

The statistics of acreage and population relating to the urban municipalities of the province show care in the tabular arrangement and will be found an instructive reference.

Generally, the Report is a mine of information on highway organization and administration, and the arrangement of the material is excellent.

An outstanding characteristic of the Report is its conciseness. The scope of the publication is so wide that its volume might easily have been three times as great, and yet in their foreword the Commissioners make it clear that their intention is to embrace only a preliminary survey of their subject. They suggest a permanent advistory commission to frame the details of technical policy.

The Public Roads and Highways Commission of Ontario is made up of Messrs. C. A. McGrath, W. A. McLean (Provincial Engineer of Highways) and A. M. Rankin, and was appointed last July.

Following are the extracts to which we have referred above:

SUMMARY OF RECOMMENDATIONS

1.—**Control.** The committing of the actual control and management of the roads, so far as possible, to local bodies—the county councils, or commissions appointed by them, boards of trustees, etc.

2.—**Finance.** The blocking out of a definite amount of work to be begun in 1915, and to be completed

Reinforced concrete arch, 65 feet span. York county, near Kleinburg.

about 1930. Cities should contribute at least to the construction and upkeep of the roads in their immediate neighborhood. The permanent construction work should be regarded as a capital expenditure, and should be financed by bond issues designed to reach by 1930 a total sum of about $30,000,000, apportioned as follows: to the province, (including the capitalization of some of the revenue from motor fees, $12,000,000; to the counties, $12,000,000; to the cities, $6,000,000.

3.—**Maintenance.** The provision for proper maintenance for every mile of permanent road work, the funds for this to be obtained from current revenues.

4.—**Township Roads.** The devoting of special attention to the improvement of township roads.

5.—**Tax on Motor Vehicles.** The putting of taxation of motor vehicles on a systematic basis, which the Commissioners estimate would produce about $400,000 in the earlier years.

6.—**Central Highways Department.** The development of a central Highways Department under the headship of a Minister of the Crown, with, as its principal permanent officials, a Deputy Minister and a Chief Engineer, and in addition an unpaid Advisory Commission of men with a genius for accomplishing big things.

In view of the impossibility of installing a new plan of road development as outlined in this report before 1915, the Commissioners believe that: (1) Counties now operating under the Highway Improvement Act should be encouraged to continue as usual their road work this coming summer, and that the regulations under the Act should be made as elastic as possible so as to allow the other counties to begin work and thereby take advantage of the aid thereunder. (2) There should be created a sufficient organization to carry on this summer the following investigations: (a) a motor survey of principal roads to determine their physical condition; (b) a traffic census to determine the present road needs of the province; (c) an investigation of main township road conditions; (d) an investigation of the Hamilton-Toronto, and Ottawa-St. Lawrence Roads, obtaining plans and specifications of same; (e) an investigation designed to outline a plan of market roads for counties not now operating under the Highway Improvement Act; (f) a determination of suburban areas about principal centres.

HIGHWAY ORGANIZATION IN CANADA

QUEBEC

Highways are divided into two classes—

(1) Provincial roads built entirely by the Government on its own initiative and under authorization of the Lieutenant-Governor-in-Council. The Road Department determines the location, nature and cost of the work, takes possession of such roads (whether or not subject to municipal authority), may expropriate rights of way and fix the share per mile or part of a mile to be paid by the municipalities interested. The latter may by resolution propose a certain contribution based either upon a general tax collection roll prepared for the purpose and submitted to the Department, or by means of a special assessment on ratepayers bound to maintain roads.

(2) Municipal roads built by the municipalities according to the two following systems:—

(a) (According to the Act of 1911). The Government grants the local municipalities half of the amount expended on macadamizing and gravelling, the maximum grant being in the first instance $1,000, in the

Applying tar—to prevent dust and preserve the road surface. One-half gallon the square yard.

Dundas street, near Toronto. Carpeted with tar and fine gravel.

second $500. The Government also refunds one-third of the amount expended for replacing wooden bridges (less than eight feet span) by concrete culverts or concrete or corrugated steel pipes. When maintenance of earth roads is in charge of the municipal council, the municipality is entitled to an annual subsidy equal to one-half of the amount expended, the maximum grant being $400 if all the roads are under the control of the council, and $200 if the by-roads only are so controlled. Road plants are loaned to the municipalities—one-half of the cost of operation being paid by them; an instructor with a Government-paid salary is also furnished.

(b) (According to the Act of 1912). The Government is authorized to borrow $10,000,000 on debentures. Local municipalities are granted appropriations for this fund, limited in the case of most towns and village municipalities to the amount required for the improvement of the main road only. County councils may also take advantage of this system, although up to the end of 1913 only one had done so. These municipalities are required to pay two per cent interest on every appropriation for a period for forty-one years, the remainder of the interest and the sinking fund being provided by the Government. The initiative must be taken by the municipalities themselves, in the form of a by-law with the deposition of promisory coupons. Roads and bridges operated under this Act remain (or become by virtue of the Act) the property of the municipality, but all macadam work done in the Province under either Act is subject to the direction of the Department of Roads, which imposes upon the municipalities specifications with inspection and acceptation of the particular roads. A monthly report to the Minister is required from the municipalities, giving estimates of the work performed and unfinished and of financial details of work being done under the officer of the Road Department. Arrangements exist whereby municipalities not wishing to assume the interest indebtedness may raise contributions by special assessment, and in cases where the roads are under charge of the corporation, the amounts paid for interest on the Government grant are deducted from the amount due from the ratepayers responsible for the maintenance of such roads. Municipalities may not benefit by both Acts.

Reinforced concrete bridge with concrete railing. Markham Township, County of York.

For the operation of the first Act (i.e., of 1911) the Legislature grants each year an appropriation out of the ordinary revenue ($250,000 in 1913). The interest and sinking fund for Government debentures under the second Act go to the consolidated revenue of the Province. Under these inspectors are road-masters appointed by the municipalities.

Nova Scotia

The head of the Highway Department is the Road Commissioner appointed by the Lieutenant-Governor-in-Council; he is an official of the Department of Roads and Mines, and has under him an assistant commissioner who must be an engineer of experience. The latter has control of two travelling inspectors to report to the commissioner as to the condition and requirements of roads and short bridges in the various municipalities. Under these inspectors are road-masters appointed by the former and acting as foremen.

Highways are divided into first, second and third classes on a traffic basis; at the present time bridge grants are limited to structures on roads of the first class, but may be extended to the other two if traffic conditions should warrant it.

Municipal road revenues are derived from the Government grant, and from commutation of Statute Labour. Co-operation between the municipal authorities and the road inspectors is encouraged. No bonds are issued and assessment is entirely under the control of Municipal Councils. There is also a "Motor Vehicle Act Road Improvement Fund," which is part of the Provincial Revenue.

New Brunswick

The Provincial Highway authority is the Provincial Road Engineer, who is an official of the Board of Public Works, and is appointed by the Lieutenant-Governor-in-Council to hold this office during pleasure. He has the supervision and general control over the building, maintenance and repair of the highways of the Province, and has under him County Inspectors of Highways wherever the latter are appointed to have control over the supervisors for each highway division in any County. There is no classification of roads.

A road tax is annually levied for the general repair and maintenance of highways in each county, every male person between the ages of 21 and 60 resident in the parish paying a poll tax of $1.50, and an amount not less than one-fifth per cent upon the assessed value of real and personal property including income. This last income tax is extended to all persons, companies and estates. Municipalities may increase the rate of this road tax, which is paid to the County Treasurer, and is expended on the order of the Minister of Public Works in the division where it is collected.

In lieu of the road tax, resident ratepayers may perform Statute Labour before July 15th in each year; if notice is given before May 1st, Road Supervisors may call upon residents to give Statute Labour in lieu of taxes.

British Columbia

The Department of Public Works has control over all roads and bridges in the Province—the executive head being the Public Works Engineer, who must prepare plans, maps and estimates for all public works, and act in a general advisory capacity. The Department is authorized to make road alterations and expropriate any private road after due notice, compensation being paid for such lands only as have buildings or form part of an orchard or garden.

A road tax of $2.00 per head is imposed on all males between the ages of twenty-one and sixty in the cities and district municipalities—military persons being exempted.

Saskatchewan

The Provincial highway governing body is the Board of Highway Commissioners, consisting of three members appointed by the Lieutenant-Governor-in-Council, one of whom shall be appointed as a chairman. They receive salaries and have duties assigned to them as may be determined upon from time to time by the Lieutenant-Governor-in-Council. There is associated with the Board for advisory purposes a committee of two members, one appointed annually by the Provincial organization representing rural municipalities and one by the Provincial organization representing urban municipalities. These members are allowed such per diem expenses and allowances as are fixed by the Lieutenant-Governor-in-Council for attendance at meetings where they are requested to be present by the Chairman of the Board of Commissioners. This Commission reports to the Minister of Public Works annually. Its duties are:—

(1) To lay out, plan and determine upon a system of public highways for the province which may from time to time be altered or modified as the Board may determine.

(2) To determine upon the most feasible and economic methods for constructing, improving and maintaining public highways.

(3- To furnish the officers of the municipalities with information respecting the construction, improvement and maintenance of public highways.

(4) To appoint such engineers, inspectors and officers as are necessary for the proper carrying out of the duties of the Board and the provisions of this Act. All such appointees shall receive such remuneration as shall be determined by the Lieutenant-Governor-in-Council.

Road construction camp in Lennox and Addington.

The Board may with the consent of the Minister of Public Works spend such sums of money as are deemed advisable upon construction and improvement of Public Highways, and it may enter into agreements or make contracts for construction of or improvements on such highways. The Lieutenant-Governor-in-Council retains the right to make such general regulations regarding the expenditures of the Board as may be deemed expedient.

An attempt was first made to divide the expenditure in all municipalities equally among them, but this was abandoned on account of the varying needs of conditions met with in the various districts. The original division of funds in 1912 for road improvements and bridges was $1,300,000 for the former and $300,000 for the latter.

The attention of the Board was directed chiefly toward the main highways but it was found there were several roads, bridges, etc., which, though not on main roads, were beyond the power of the municipalities to construct and were taken over by the Board. The Board assists municipalities to the extent of 50 per cent of the cost of improvements made when these improvements are according to the regulations adopted by order of the Lieutenant-Governor-in-Council.

Educational work has been attempted through the distribution of bulletins and specifications, by correspondence and through the staff of inspectors. A limited amount of experimental work has been attempted with only partial results.

The Board has instituted a Road Drag Competition with excellent results among the different municipalities. The Board has so far devoted its energies to the main roads, leaving the feeders to the municipalities, except insofar as concerned its advisory capacity. The Board finds that best results are obtained by its own road gangs who are building roads exclusively, and better work is done at a lower cost than rural gangs recruited from the farmers.

All bridges over 20 feet span are constructed and maintained by the Commission, which also operates and controls all ferries and drainage and water supply throughout the Province, with control covering all surveys for purposes of road diversion.

Methods and Cost of Constructing a Bituminous Gravel Concrete Surface

THE use of gravel aggregate in the construction of a bituminous concrete surface in New York State is discussed by S. J. Stewart in the Proceedings of the American Society of Civil Engineers.

The writer designed a pavement consisting of a mixture of asphalt and gravel in the proportion of 1 cu. yd. of loose gravel to an average of 20 gals. of asphalt, the gravel containing not less than 10 per cent. of clay. The gravel was bank run, the largest particles of which were 2 ins. in the longest dimension, containing sufficient fines to fill the voids partly. The bitumen was a fluxed natural asphalt with a penetration between 10 and 13 mm. when tested for 5 seconds at 77 deg. F., on a No. 2 needle weighing 10 grammes.

The gravel was heated in a mechanical revolving dryer with a temperature of more than 225 deg. F., after which the asphalt, heated to not less than 275 deg. F., was added; then the mixture was placed in a revolving mixer until thoroughly and completely coated with bitumen. The mixture, at not less than 225 deg. F., was spread on the prepared bottom course with shovels from dumping boards and raked to a uniform surface, with hot rakes, after which it was rolled with a self-propelled roller weighing at least 10 tons, until it was thoroughly consolidated.

On some sections of this pavement there was placed ½ in. of gravel screenings containing not less than 10 per cent. of clay which was saturated with water and rolled thoroughly and continuously until a clay mortar had been obtained. This process filled all the surface interstices with a gritty and adhesive substance which made the road practically "non-skid." In a short time the traffic drove away all surplus screenings, leaving a mosaic surface.

A different method of treatment was applied to this form of pavement in the more thickly settled communities. After the mixture had been rolled, it was covered with a coat of hot oil as a seal coat, this seal coat being applied in November. In the following spring, under the action of the sun, the road bled to some extent, and became so sticky in a few places that the oil adhered to wagon wheels, which pulled up some of the top course. This condition could have been avoided if the authorities in charge had covered the pavement with sand or gravel screenings as soon as it became apparent that the hot oil had a tendency to bleed. No material harm was done, however, as the continuous traffic carried sufficient sand and dirt on the pavement so that in a short time the stickiness of the oil had disappeared.

Such treatment obviates the general complaint against the so-called stone-mixing method pavement where a greater quantity of asphalt is used and where the seal coat is of the same consistency as the asphalt binder in the top course proper. These objections arise from the hardness and slipperiness of the surface, which, during the greater portion of the year, make it undesirable for horse traffic because of the former characteristic and to motor traffic on account of the latter.

It is suggested that, where the hot oil is omitted at the time of the original construction, the mosaic surface be covered with a hot oil treatment of one-half gallon per square yard during the following year. With the hot oil as a squeegee course, in place of the seal coat of the same consistency of the bitumen, the pavement proper gives a less hard and slippery surface, which is desirable on country highways.

The writer's experience has convinced him that large plant, costing from $5,000 to $8,000, is not necessary in order to construct this pavement successfully, and that equally good results can be obtained from the use of small mixers costing from $1,500 to $2,000.

This pavement without the oil treatment cost about $0.85 per square yard, and with an oil seal cost about $0.90 per square yard for a pavement 2½ inches in depth. This cost compares favorably with similar figures for mixing-method pavements in other parts of New York State.

The writer quotes from a statement attributed to a superintendent of highways, of New York State, relative to costs of similar pavements of graded stone material, as follows:

Item.	Cost per sq. yd.
1½ in., California asphalt	$1.20
2 in., Topeka	1.20
2 in., Warrenite	1.30
2 in., bitulithic	1.60

The gravel used in this pavement cost approximately $2.35 per cubic yard f.o.b. destination, but where material can be obtained near the site of the works the cost of $0.85 per square yard can be materially reduced.

From observation of mixing-method pavements laid in New York City and vicinity, with graded stone as a mineral aggregate, it is ventured that the percentage of disintegration is as great, if not greater, than in the bituminous gravel pavement laid during the same period of time. In fact, after 1 year's wear, out of a total of 112,000 sq. yds., or 0.04 of 1 per cent. less than 45 sq. yds. of this gravel mixing-method pavement had disintegrated.

The road which received the treatment of hot oil in a squeegee course was dug up in many places during the year following its completion for investigating purposes, and, where removed, the material thrown back retained its vitality to such an extent that the top course healed itself so that a casual observer could not discover where the pavement had been disturbed.

Cracking in Concrete Roads

PROBABLY more criticism of concrete pavements is centered on the cracks which occur than upon any other features of this kind of construction. A. N. Johnson, state highway engineer of Illinois, in a paper before the American Road Congress attributed the formation of cracks to unequal settlements of the subgrade, supplemented by external stress due to the passage of heavy traffic or to the movement of the slab under temperature changes. In commenting upon this, Henry S. Spackman refers to experiments conducted by him which showed that when concrete is mixed as wet as it generally is in modern road work it shrinks during the first twenty-four hours and then expands during the next three or four months, the shrinkage being undoubtedly due to a draining out of the water and the expansion to the continuation of the chemical action, which continues for months and even for years in a continually lessening degree. In view of this shrinking which begins almost as soon as the concrete is laid, it seemed impossible to prevent the cracking of the pavements unless the exudation could be prevented. Mr. Spackman has experimented with the addition of hydrated lime for this purpose, and compared 18 test pieces to which hydrated lime had been added to the extent of 10 per cent. of the amount of cement in some instances and 20 per cent in others, and 9 test pieces containing no lime. During the first twenty-four hours the average contraction for those containing hydrated lime was .007 per cent, as against .015 per cent for the pieces containing no hydrated lime. At his suggestion also the Office of Public Roads laid a short stretch of road at Chevy Chase, Washington, D.C., using hydrated lime, and another was laid near Salisbury, Md. These experiments all lead him to believe that the addition of 10 to 15 per cent of hydrated lime will be found beneficial not only in reducing cracks, but also in eliminating the formation of holes and soft spots. Such addition, he says, not only causes the mortar to hold the water, but the more plastic and viscous mortar eliminates the segregation of the cement from the sand and secures a more homogeneous mixture, lessening the liability of pockets of material deficient in cement.

Violet-Ray Sterilization for Niagara Falls Filters

NIAGARA Falls, N.Y., is to have a municipal ultra-violet-ray sterilization plant. Contract negotiations have been made for a 35-lamp installation with the R. U. V. Company, Inc., of New York. "Pistol" lamps will be used, seven in each of five concrete canals, although the company estimates twenty-five lamps only will be required to handle the capacity of the plant, 16,000,000 gal. daily.

The cost of the canals and lamp installations will be $19,800, while the city will erect a building and transformers to change the current from alternating to direct, at a cost of $2,200. Approximate costs per 1,000,000 gal. for maintenance are guaranteed as follows: Current, 7 cents; lamp renewals, based on a 2,900-hour life, 60 cents.

About 1 gr. per gallon of coagulant and 5 lb. of bleach per 1,000,000 gal. have been used at this plant, the total cost of chemicals running about $1.50 per 1,000,000 gal. It is hoped that the coagulant can be cut in half and still give a clear water, in which case the ultra-violet-ray installation will prove economically advantageous.

The channels in which the water will be sterilized will be of concrete, 2 ft. wide, 3 ft. deep and 26 ft. long, affording a contact period of 30 seconds with the ultra-violet rays. The lamps are spaced 30-in. apart and in front of each is a baffle of wired glass in which a rectangular opening is cut to divert the water against the quartz tube.

Quebec Leads in Road-Making Instruction

At the present time when the good roads movement is developing rapidly throughout Canada, it is encouraging to find that a school for the practical study of road-making, which was established at Acton Vale, Que., following the inauguration of the government's road policy, has justified its existence. It will therefore be of interest to mention that more than 175 men from different parts of the Province of Quebec attend the school. There are two sets of machinery on the ground, and four different kinds of road work are being carried on; gravel, macadam, asphalt and concrete. The school is in charge of competent engineers from the Department. The programme for this year's work includes the building fo four new highways by the government. Government subsidies for the improvement of roads are being constantly asked for. There are now 174 road-making outfits in use through the Province, which has been divided into 12 sections and an inspector appointed for each. Mr. A. M. Evans, chief government engineer of highways for the Province, made a survey of the Sherbrooke to Derby line road a few days ago. Large gangs of men are now at work, and the number will be increased shortly. Dangerous railway crossings will be eliminated and sharp curves done away with. When finished the road will be one of the best in the Dominion.

North Toronto's Sewerage Project

The new sewerage system for North Toronto which the city must construct under the terms of an agreement by which the township of North Toronto was annexed to the city, is estimated to cost more than $4,000,000. Two systems were considered originally; One contemplates separate sewers for storm overflow and for ordinary purposes, at a cost of more than $6,000,000. The alternative system, which is the one recommended, will have sewers to serve both purposes at an estimated cost of $4,144,256. The system is to be in two divisions, one with lateral sewers, trunk sewers, outlets and disposal plants. The sewage from the lateral sewers, 144 in number, will flow into 13 local trunk sewers, extensive enough to provide for the future development of the district. Of the two storm sewers which will be necessary, one will pass through the Waterworks Park, and the other along Bayview Avenue to the Don River. The sewage disposal plant will include tanks for the treatment of storm water and Imhoff tanks for sewage, and the plant will be so built that additions can be made as required without disturbing the general plant. The second division of the system will be somewhat similar. There will be 139 lateral sewers, 7 local trunk sewers, 2 storm outlet sewers, and one outlet sewer.

What will probably amount to the largest yardage of concrete highways ever built in a single year within a radius of forty miles was started in May when Milwaukee, Sheboygan, Racine, and Kenosha Counties, Wisconsin, commenced work on fifty-two miles of concrete roads.

Municipal Engineering Work at Hamilton

THE annual report of the City Engineer of Hamilton (Mr. A. F. Macallum) just to hand is instructive as to the scope of the work done in the various engineering departments of a growing city with a population of 100,000. During 1913, Hamilton witnessed exceptional development and the City Engineer's department experienced the heaviest work of a single season in its history. Waterworks construction was heavy, the various city mains being completed, as well as a 36-in. rising main from the pumping station at the Beach. The new 4-foot intake into Lake Ontario, 2,120 feet in length, was laid along with the intake and crib by the contractors, Messrs. John Danforth & Company, of Buffalo, N.Y. This firm also completed the laying of the 4-foot conduit between the wells and the settling basins.

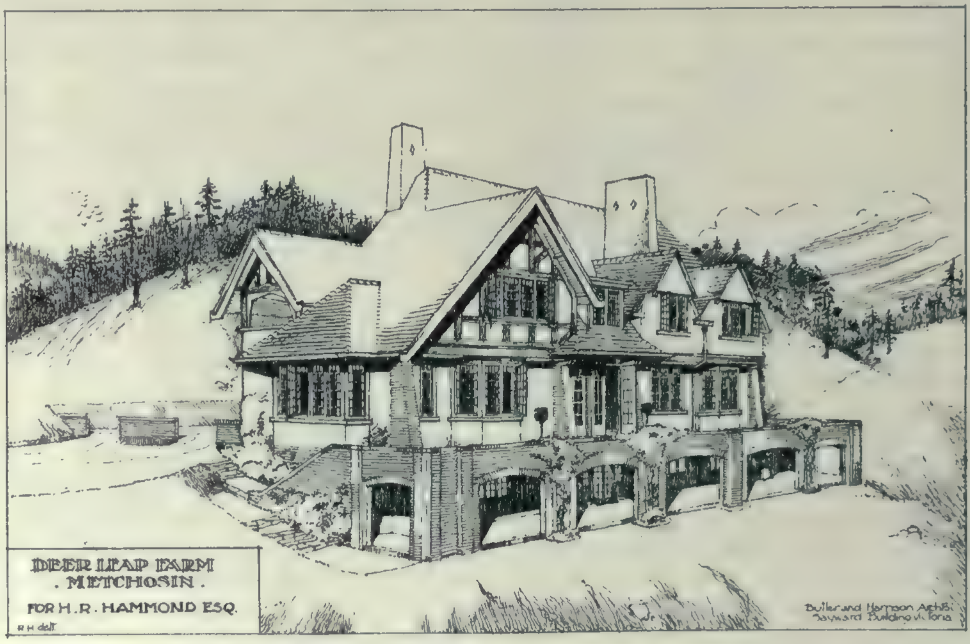
The new pumping station at the Beach, with foundations, has been completed, and pumps, motors, transformers, valves and headers have been installed. This new pumping station has installed four pumping units of six and one-half million gallons each, with foundations and accommodation for two more pumping units of similar capacity.

A new high level pumping station was built at the head of Ferguson Avenue, and four electrically-driven turbine pumps, each of one million gallons capacity, were installed. Two of these units pump to the present high level reservoir, giving a supply for the high level district equal to three times the steam units on the same service. The other two units pump to a standpipe on the mountain top through a twelve-inch main laid during the season. This standpipe, which is one hundred feet high and holds 80,000 gallons of water, was built by The Des Moines Bridge and Iron Company. By placing these mountain pumps at the Ferguson Avenue station, the cost of maintenance and operation was much reduced. The Wentworth street station has been abandoned, and the air compressors and motors have been removed. The head from the Beach pumps is now utilized in cutting down the necessary lift to the high level and mountain top. The new pumping unit at the Beach and high level stations were built and installed by the Canada Foundry Corporation and Canadian General Electric Company.

The necessity of increased reservoir capacity is now under consideration, and also the desirability of installing steam turbines to further insure the continuity of the water supply.

Construction was commenced upon the West End Disposal Works. The grit chambers and sludge beds were finished, also the excavation and piling for the six Imhoff tanks. Three of these tanks were partly built when work was ceased for the season. The secondary fillers of the East End plant were not used during the year, the sewage receiving only sedimentation treatment in the septic tanks. These tanks will be reconstructed to the Imhoff type and new secondary filler beds installed.

A new asphalt plant was built in the east end, on Gage Avenue, capable of turning out 1,500 yards a day. With the two plants running, and good weather conditions, more asphalt pavements were laid than during any previous year. Creosoted wooden blocks and asphalt concrete pavements were also laid upon a number of streets.



An Attractive Victoria Residence

THE picturesque country residence illustrated herewith is characteristic of the type of dwellings that has earned for Victoria its reputation as a city of homes. This residence is being erected by Grayson & Sons, contractors, of Victoria, at Metchosin, a near-by suburb, for Mr. H. R. Hammond at a cost of $20,000. The stucco finish, brown-stained woodwork and gabled architecture give a quaint old-country effect that is further accentuated in the interior, where the beam work and high open fireplaces are all built in Old English style. Messrs. Butler & Harrison, of Victoria, prepared the plans.

The Eldorado Oil Company, lately organized, have secured leases on 1,198 acres distributed throughout the province of Alberta and will shortly commence drilling for oil. The company is capitalized at $250,000.

Proposed G. T. P. Station, Regina.

Constructional News from the Saskatchewan Capital

Correspondence of the Contract Record

Regina, June 26, 1914.

BUILDING work in Regina at the present time is quite active and the outlook for a good season is improving all the time. Mention of many important buildings under construction has been made in previous issues of the Contract Record, but the constructional story of Regina has many chapters.

Reproduced herewith is the architects' perspective of the proposed G. T. P. station for Regina. This building will be connected with the hotel by means of an underground passage. The tunnel, train sheds, power house, laundry and station will cost something like one million dollars. In another view we give a glimpse of the G. T. P. railway hotel now under construction at Regina. The contract price for this building was slightly over one million dollars. The hotel will be named the "Qu'Appelle" and will be fourteen storeys in height. The work of excavation and the putting in of the footings was commenced last year, but some difficulty was encountered in connection with the footings owing to the clay ground. Steel work is now in progress. The third of the illustrations is from a progress photograph of the addition to the Regina hospital.

Messrs. R. J. Lecky & Company have already commenced the work of erecting one of the towers on the Regina College building. The building proper was erected two years ago, but the contract for the two large towers was only let re-

Addition to Regina hospital under way.

cently. The completion of this work will give the college building a decided improvement in appearance.

The city of Regina has accepted an offer for $1,505,000 worth of debentures for local improvement works. This will provide sufficient funds to carry on all the improvement works decided upon. As soon as more money is required for this work, the city is in a position to market an additional debenture issue of $1,500,000 approved by the ratepayers several months ago.

Two new schools will be erected in Regina during the present year—one a six-room building to be built at Premier Place subdivision and the other a cottage school to be built in City View.

Still another industry has been added to Regina's growing list. Alexander Harrison, of Minneapolis, in conjunction with Regina business men, having arranged to erect an ice factory. The factory will have a capacity of thirty tons daily.

A new vaudeville theatre is to be erected in Regina, excavation having already been commenced. The cost of the building will be in the neighborhood of $65,000.

A large courthouse and land titles building will be erected at Humboldt by the provincial government, Messrs. Parsons Construction Company, of Regina, having been awarded the contract. The contract price is $79,990.

G. T. P. Hotel now under construction at Regina.

A thriving little municipality has sprung up on the very limits of Regina, and has assumed the name of North Regina. This action came as a result of the city's refusal to include this area within the city limits. As the population was large enough to apply for incorporation as a village, no time was lost in taking these steps. The Grand Trunk Pacific Railway shops are included in the territory of this new village which is arranging for the erection of municipal buildings and the installation of local improvement works.

The Engineering Society of Regina recently inspected the power house and investigated the system in operation there.

The new wing of the Regina General Hospital will be completed early in August, according to a report prepared for the hospital board.

Mr. L. A. Thornton, Works Commissioner of Regina, has prepared a detailed report dealing with the proposed nurses' home. The cost of this building will be $68,000.

Miscellanea

As the Canadian Northern Railway are unable to build their proposed station on Dorchester street, Montreal (from plans by Warren & Wetmore, New York), in time to deal with the traffic on the Mount Royal tunnel line, the directors will construct a depot on Lagauchetiere street. This will be used as an express depot when the Dorchester street building is erected.

The Canadian Pacific Railway will shortly have 1,095 miles of double track between Port Arthur and Calgary. This conveys some idea of the work involved in duplicating the whole system, which comprises some thirteen thousand miles of track. The double track will be built in a different way from the original railway. The present double track will offer a finished railway both as regards width of rails, strength of bridges and perfection of road-bed.

Messrs. Mills Bros., dealers in contractors' equipment, Toronto, have received an order from the Lake Shore Sand & Gravel Company, Limited, for their sand and gravel screening plant to be erected at Frenchman's Bay, Ont. The plant will consist of a bucket elevator with hopper and apron feeder, four screens (conical type, six feet long and set in pairs) driven by rope drive. Discharge will be handled through bottom gates in the three bins to belt conveyors. The capacity of the elevator and screens is 600 cu. yds. a day and the unloading conveyors will handle 300 cu. yds. an hour.

A new motor highway, which is claimed to be one of the finest ever laid down by motor road-builders, will be opened for traffic next October at Berlin, Germany. The road is six and a quarter miles long with parallel tarred macadam roadways, twenty-six feet wide and separated by grass plots of equal width. The work involved an outlay of over $500,000. It is designed essentially for speeding, and includes groves scientifically banked. The road will be finally opened as a race course in 1915, when an international contest for speed motoring will be arranged by the Imperial Automobile Club.

Enterprising arrangements are being made with a view to making a great success of the Fourth American Congress which is to be held in Atlanta, Georgia, from November 9-14 next. Entire streets are to be re-paved and roofed and thus turned into adjuncts to the large auditorium. Accommodation is to be provided for more than five thousand guests and arrangements have been completed for what will possibly be the largest government exhibit ever made. The Business Manager of the Congress is Mr. Chas. P. Light, who is now in Atlanta taking hold of the arrangements of exhibits and allotting space for the exhibitors.

A new railroad with Calgary, Alta., as one of its terminals is contemplated. The line is known as the Western Dominion R. R. It has been located from Calgary southerly to the South Fork of the Old Man River, thence southeasterly, via the towns of Pincher Creek and Cardston to the International boundary, near to the 23rd range west of the fourth meridian in southern Alberta. The length of the main line is approximately 201.2 miles. The company is not ready as yet to begin building, but probably will put a portion of the road under construction during the present season. The approximate quantities involved in the construction of the road include 3,636,069 cu. yds. of earth excavation; 106,501 cu. yds. of rock excavation; 3,568,980 cu. yds. embankment; 15,490 lin. ft. of trestles and 19,830 cu. yds. of masonry. Steel bridges will be constructed over all river crossings, with an approximate total length of 5,530 lin. ft. The bridge will be an equivalent of Coopers E50 specifications. Mr. J. N. Hayward Cornell, 29 Broadway, New York City, is chief engineer of the Western Dominion Railway.

Personal Mention

Mr. R. W. Brock, deputy minister of mines, Canada, is to devote part of the summer to a geological study of the Bulkley Valley, B.C.

Mr. William C. Rowse, M.E., who is a graduate of Purdue University, has been appointed professor of mechanical engineering in the University of Manitoba.

Mr. F. P. Adams

Mr. Frank P. Adams, City Engineer of Chatham, Ont., was born at Brantford in 1878. He was educated at Brantford and proceeded to the School of Practical Science in 1898. His earliest connection was with the Ontario Peat Development Company. For several years he was engaged in railroad and township surveying work. Then he became assistant engineer on the Grand Valley railroad. Later he went to Brantford as Assistant City Engineer and while there had charge of storm sewer and pavement work. He also designed a couple of reinforced concrete bridges at Brantford under the direction of Mr. T. Harry Jones, city engineer. (A description of these bridges has been published in this journal.) Mr. Adams was identified with Mr. Willis Chipman as assistant engineer on municipal work at Midland, Weston and Steelton. He was appointed City Engineer of Chatham some three years ago.

City Engineer Adams, of Chatham, Ont.

Mr. M. C. Hendry of Toronto, has been appointed chief engineer for the Manitoba Hydrographic Service of the Dominion. He has already taken up his duties in the new sphere.

Mr. S. H. Parsons has retired from the position of supervisor of buildings and purchaser of supplies for the Protestant Board of School Commissioners, Montreal. He is succeeded by Mr. E. B. Palmer.

Mr. C. F. J. Galloway, M.E., of the British Columbia Department of Mines, is at present investigating the mineral-bearing areas along the Grand Trunk Pacific Railway line, working east from Hazelton, B.C.

Mr. A. B. Garrow, who was for several years in the Toronto Main Drainage Department, has received an appointment with the Toronto Harbor Commission, and is in charge of the re-designing of the sewer outlets along the city's waterfront in connection with the harbor development scheme.

Mr. W. Hartley Patterson

Mr. W. Hartley Patterson, a member of City Engineer Rust's staff at Victoria, to whom the presentation of a service of plate was made recently on the occasion of his marriage (as recorded in the Contract Record of June 10) is a native of Ireland. He was educated in England and on the continent. In the early "nineties" he entered upon a five years' apprenticeship with Mr. W. H. Lynn, R.H.A., a prominent architect who has been actively engaged in the practice of his profession in Ireland for upwards of sixty years. Subsequently Mr. Patterson became associated with the firm of Graeme-Watt & Tulloch, architects and civil engineers, of Belfast. With this firm he made a special study of municipal and institutional architecture and in 1906 he was sent to Germany to obtain data on the planning and construction of asylums and hospitals. Coming to Canada in 1909, he settled in Victoria and became head draughtsman and designer for Messrs. G. C. Mesher & Company, with whom he was identified for upwards of two years. In the early summer of 1912 he joined the City Engineering Department at Victoria under Mr. C. H. Rust and is now occupied chiefly in the preparation of special structural plans and in drawing up specifications and details for the various departmental buildings. Mr. Patterson is a member of the Ulster Society of Architects and of the British Columbia Society of Architects. His new "partnership" is not without professional interest, for his marriage was to Miss Violet Woodhouse, daughter of the late Henry Woodhouse, C.E., of Stafford, Eng., for many years consulting engineer to the London & Northwestern Railway.

Mr. W. Hartley Patterson, Victoria.

Mr. Alfred S. Peene, who passed away a few days ago at Hamilton, Ont., was for many years one of that city's leading contractors. He was born in Kent, England, in 1830, and resided in Hamilton ever since his arrival in this country. He is survived by two sons, one of whom, Mr. A. W. Peene, is a well-known Hamilton architect.

Mr. Morgan Bransby Williams, who probably had more to do than any other man with the construction of the earlier railroads in the British Isles, died on June 22. He also planned and built many of the Italian railroads, as well as thousands of miles of Russian lines. He was born in 1825 in Wales, and after retiring from the engineering profession was for twenty years Vice-Chairman of the Metropolitan Bank of England in Wales.

MAINLY CONSTRUCTIONAL

EAST and WEST — FROM COAST to COAST

EASTERN CANADA

Port Arthur, Ont., city council has approved the estimates of the city engineer to expend $36,140 on improvements to Meikle Park.

York township council has been asked to consider bylaws for the issue of debentures amounting to $98,000 for structural alterations and additions to schools.

Canadian David E. Kennedy, Limited, were incorporated recently as contractors, engineers and dealers in contractors' supplies. The head office of the concern is at Montreal.

Some additional underground conduits are to be constructed in Montreal, the Quebec Public Utilities Commission having passed the plans for Notre Dame, McGill, Craig and St. James streets.

The London Builders' Exchange are making enterprising arrangements in connection with their fourth annual excursion, which is to be held at Toronto, July 11 next. The Secretary of the Forest City builders is Mr. F. S. Barclay.

The St. John, N.B., Board of Trade has received inquiries from a brick-making firm regarding the opportunities for the local of a brick-making plant in St. John. The matter is at the present receiving consideration from the civic authorities.

The new cathedral at Chicoutimi, the estimated cost of which is placed at $300,000, is nearing completion, the roofing work now being in progress. The architect is Mr. R. P. Lemay, and the general contractor, Mr. J. Giroux, both of Quebec.

The report of the Canada Brick Company, Montreal, states there was a loss from operations to December 31, 1913, of $8,524. This was due to the general slump in the building trade accompanying the financial depression throughout the Dominion.

A survey is at present being made on Wolf Island in connection with a tow road system which it is proposed to establish on that island in connection with the highway scheme. The survey is being carried out by an engineer of the Ontario Highway Commission.

Messrs. Jinchereau & Lamonde are the general contractors for a school building now in course of erection at Quebec. The building is four storeys high, of stone and Scotch brick construction, and will cost $200,000. Mr. R. R. Lemay, of Quebec, is the architect.

Mr. W. H. Wardwell, M.E., designing and contracting engineer, Montreal, has secured the contract for the reinforced concrete structure for the Molsons Bank, at the corner of St. Lawrence and Ontario streets, Montreal. Messrs. Turner & Carless, Montreal, are the architects.

The Day Building Company, Limited, has been incorporated with a capital of $40,000. The provisional directors are William John Cook, James Linklater, Harry J. Evans, George Edmond Buchanan and Miss Jessie McFeetors. The headquarters of the company is at Sudbury, Ont.

The Ambursen Hydraulic Construction Company, of Canada, Limited, Montreal, have been awarded the contract for Dam No. 1 of the Eugenia Falls Development on the Beaver River, Ont., for the Hydro-electric Power Commission. The structure will be two thousand feet long by fifty feet high and will be of the Ambursen type. The contract for No. 2 dam has been let to the firm of Hyland, Seriven & Whyte, of Belleville, Ont.

J. A. King & Company (Canada) Limited, has been incorporated with a capital stock of $150,000, as manufacturers of and dealers in fire-proof and other building materials and supplies; also to carry on the business of general contractors. The head office of the company will be at Montreal.

The Moncton, N.B., Board of Works, has planned an extensive street paving scheme to cost over $44,000 of the $50,000 appropriated by the city council for permanent street works. The estimate submitted by the city engineer provides for the use of bituminous material, macadam and tarvia.

Judge Beaudin has been appointed chairman of the board of conciliation in the dispute between the Montreal General Contractors' Association and the carpenters. The latter claim an advance of 2½c an hour and an eight-hour day. The association are also in negotiation with the bricklayers as to working conditions.

Works aggregating in cost forty-six million dollars are being started by the Public Works Department of the Dominion Government. The undertakings consist of harbor and river works, and public buildings. Work on the four-million-dollar departmental buildings in Ottawa is likely to be delayed considerably.

Messrs. Wilson, Townsend & Saunders, engineers and contractors, Toronto, have been awarded the contract for the construction of a 4-ft. 6-inch tunnel under the C. P. R. and C. N. R. right-of-way at Leaside, Ont. The tunnel will be approximately one thousand feet long, and will be of brick construction. It will be 40 to 45 feet underground, and will involve an outlay of some twenty thousand dollars.

Messrs. Rouly & Summers, civil engineers and contractors, Toronto, are engaged in carrying out an extensive scheme of road improvements in the County of Huntingdon, P.Q. Mr. T. J. Routly visited Quebec recently and interviewed the officials of the Road Department with regard to certain points in construction. The work forms part of the programme of road building and maintenance initiated by the Provincial Government.

The ratepayers of York township, Ont., are being asked by the Central Ratepayers' Association to consider a proposal submitted by a United States firm of engineers whereby the firm will construct a water works system in the township and guarantee a water supply to the residents at a fixed price per thousand cubic feet, the cost of construction to be borne entirely by the firm. It is proposed that the water be brought a distance of twenty-five miles.

A large number of grants for important constructional works have been secured for Hamilton during the last session of Parliament. Of the $620,000 voted for public works the most important single item was $250,000 for the work at Stipe's Inlet. This is part of a big scheme for harbor improvements, the plans for which have been worked out by the local Harbor Commission. Another important grant is that of $165,000 for the purchase of property and the starting of work on the new customs house and post office extension at the corner of Main and John streets. Other important items are the construction of the revetment wall and the reclamation of land in the vicinity; $50,000 for a wharf at the end of Wentworth street, and a grant of $40,000 for a new east end post office on Barton street.

Irregularities alleged by Chief City Engineer Janin, Montreal, to have been found in connection with sewer work by contractors in Notre Dame de Grace ward led the board of control a few days ago to decide on an official enquiry into the manner in which certain sewer contracts were carried out last summer. Pending the investigation between $50,000 and $60,000 of sewer contractors' guarantees on deposit will probably be held by the city.

The Excelsior Electric Manufacturing Company, Limited, has been incorporated with a capital of $40,000, to manufacture electric motors and to deal in electrical machinery of all kinds; also to purchase as a going concern the plant and machinery of the Excelsior Electric Manufacturing Company. The company's head office is at Toronto, and the provisional directors are Lewis Traver Rutledge, Newton Howard Manning, William E. Gorman, Ethel M. Rutledge and William M. Hall.

Three large building permits were taken out from the Toronto city architect's department on June 22. Wm. Croft & Sons, the smallware manufacturers, are to put up a six-storey brick warehouse on Wellington street west, near Spadina avenue, to cost $66,000. The Dominion Bank will build another branch on the corner of Logan avenue, at a cost of $22,000, and the Cosgrave Brewing Company will erect a brick and steel malthouse on Simcoe street, near St. Patrick street, at a cost of $15,000.

The National Contracting Company, Limited, with head office at Toronto, has been incorporated with a capital of $40,000, to acquire the business, goodwill, plant and machinery of the partnership carried on at Toronto, under the name of the National Contracting Company. The new company will continue the business of general contractors, and will also deal in contractors' and builders' machinery and supplies. The provisional directors are William Joseph Haynes, Frederick Reeves and William Myddleton Hall.

The Montreal Arena has made application to the Westmount city council for permission to establish an ice manufacturing plant on a site adjoining the Arena and fronting on St. Catherine street and Wood and Western avenues. The present intention is to operate the plant only in winter, for the purpose of insuring a perfect sheet of ice throughout the hockey season, irrespective of weather conditions. The plant will have a daily capacity of one hundred tons refrigeration. The work will be begun as soon as the permit is secured.

A ten-storey office building, to cost in the neighborhood of $300,000 is to be erected shortly on a site on the southwest corner of Terauley and Albert streets, Toronto, by Messrs. A. A. Barthelmes and Frederick Courtemanche, both of Toronto. The new structure will be of steel and brick construction, and will possibly have a wide terra cotta exterior. The property, which is now vacant, has fifty feet frontage on Teraulay street and a frontage of one hundred and sixty-four feet on Albert street. Construction work is expected to begin some time this month.

The controversy relating to the suggested Colborne street bridge to connect the King Edward Hotel with an annex which the company propose to erect, has resulted in the application being refused by the Toronto Works Committee on the recommendation of Commissioner Harris. Mr. E. J. Lennox, architect for the King Edward Hotel, appeared before the Works Committee and contended that the only possible enlargement of the hotel was across the street to the south of the existing building, and that the hotel people had planned to expend a million dollars on their annex.

In a time of comparative dullness it is gratifying to have Building Inspector McNamara, of Fort William, report to the Contract Record that the past month witnessed the busiest period of building ever experienced in the history of his city. The prevailing activity, he states, applies chiefly to dwellings costing $2,000 and over. On residential work, operations are being pushed forward aggressively in almost every section of the city. By the end of the present season it is estimated that there will be one thousand more dwellings in Fort William than there were a year ago. So far the building total is not ahead of last year, but this is owing to the conspicuous absence of permits for buildings of the larger type.

The North Toronto drainage system, recommended by Mr. R. C. Harris, Commissioner of Works, has been adopted by the city council of Toronto. The entire work is to cost $4,144,256, which includes provision for surface and domestic sewage. The Imhoff disposal system is to be used on the plant which will be erected in the vicinity of the upper valley of the Don River, and will be so constructed as to allow of future extension. The alternative scheme, adoption of which would incur an additional expenditure of about two and one-quarter million dollars, was also before the works department. The sewage disposal plans for divisions one and two will consist of stand-by tank for treatment of storm water. Imhoff tanks, chlorinating devices, sludge drying beds and sprinkling filters, or such other equipment as may be considered suitable. It is claimed that sewage passing through such a plant scientifically designed and constructed, will be inoffensive. The total estimated cost of plant number one for present requirements, including the site for future development, is $408,250, and for plant number two, $305,900. Of the total cost of the system and repairs, the ratepayers will assume about $1,362,311, while the city's share is estimated at $2,781,945.

WESTERN CANADA

The Arnold Art Stone Company, Limited, Winnipeg, Man., has been incorporated with a capital of $30,000.

At Calgary, a by-law to raise $300,000 for extensions to the electric light system has been approved by the ratepayers.

The British Columbia Water-Works Supplies, Limited, is a new company incorporated recently at Vancouver with a capital of $25,000.

The cost of building in Regina this year is said to be reduced considerably owing to willingness on the part of the contractors to accept small profits.

At Winnipeg, Man., plans have been filed with the board of control for the construction of a bridge over the Assiniboine River, at an estimated cost of $200,000.

At Vancouver, B.C., it is proposed to construct a concrete-lined tunnel from Burrard Inlet to the C. P. R. yards at False Creek. Plans are now being prepared for the railway.

At Saskatoon, foundation work is in progress on the Students' Residence in connection with the University of Alberta, which is being erected at an estimated cost of nearly $200,000. The architects are Messrs. Brown & Vallance, Montreal.

A noteworthy Winnipeg incorporation is that of the Metal Shingle and Siding Company of Manitoba, Limited. The new concern is capitalized at $500,000. The provisional directors include Messrs. N. J. Dineen, H. P. Grundy and F. W. Louthood.

Mr. Geo. Craig, city engineer, has made a recommendation to the city commissioners of Calgary, Alta., against the granting of a site to a company for the erection of a public mausoleum in the city, unless the company gives a guarantee for its maintenance.

An iron and steel manufacturing company has been anxious for some time past to secure a suitable location in the municipality of Burnaby, B.C., with a view to setting up an industry in the near future. The matter is at present receiving consideration by the secretary of the local Board of Trade.

Preliminary plans and estimates for the proposed Johnson street bridge at Victoria, B.C., have been completed by Mr. Rust, city engineer, and on completion of the final agreement, the terms of which have already been approved by the provincial government, the C. P. R., B. C. Electric Company, and the city council, the city will call for tenders for the construction of the bridge and prepare the necessary by-laws for providing $450,000, the estimated cost of the structure.

Moose Jaw, Sask., city council is thinking of acquiring a gravel pit with a view to obtaining gravel for macadamizing the principal residential streets of the city. In a report to the works committee, Mr. Geo. D. Mackie, city engineer, states that the cheapest method of securing good surfaces is by the use of some sort of macadam such as gravel screened, graded. In order to yield a satisfactory surface this would require to be treated with some patent road material such as rocmac.

Official announcement was made by Hon. George E. Foster recently that the Dominion Government had selected the site for the new Pacific coast government transfer elevator. It will be built on the site of the government drydock at Vancouver. Plans for the elevator will be prepared at once, although it will be two or three months before tenders can be let. It is expected that the elevator will be modelled largely on the plan of the government elevator at Port Arthur, though with possible changes to meet Pacific coast requirements.

There is a possibility that the bitulithic contracts let in 1912 for street paving at Vancouver, B.C., may be carried out this summer. The Columbia Bitulithic Paving Company is in communication with its eastern headquarters regarding a proposal to take bonds for the work. The contracts let for paving were Queen's avenue, from First street to Sixth street, $42,000; Fifth street from Third avenue to Sixth avenue, $42,000, and Sixth street from Fourth avenue to Sixth avenue, $19,000; additional charges for house connections, lights, depreciation of bonds, etc.

Canadian Railroad Development

Surveys are in progress for seven and one-half miles of street railway at Sudbury for the Sudbury & Copper Cliff Railway Company. The estimated cost is placed at $200,000.

Work on the extension of the Hydro-electric transmission line from St. Thomas to Windsor, Ont., has progressed so far that the engineers of the Commission hope that the line will be ready to deliver power to Windsor about the end of July.

Rapid progress is being made on the Alberta Central Branch of the C. P. R. west from Red Deer, Alta., and it is anticipated by the construction department that a regular service on this line will be established out of Red Deer during July.

Two parties of C. P. R. engineers and surveyors are working on the preparation of surveys to carry the line of the Esquimalt & Nanaimo Railway northward along the shore of Vancouver Island. One surveying party is working south of Campbell River and one north, the latter proceeding along the trail built by the government into the Salmon River Valley. It is surmised that the intention of the C. P. R. is to build eventually to the north end of Vancouver Island.

The Canadian Northern Railway Company expects to be able to obtain the two-million-dollars required for the completion of its transcontinental system from coast to coast. In the meantime the company is planning to go ahead with all its extensions and improvements. In a statement made a few days ago Sir Donald Mann, first vice-president of the company, announced that about a year hence the company expected to have all the various sections connected up and through trains from the Atlantic to the Pacific. The line along the north shore of Lake Superior is being pushed through rapidly, despite great engineering difficulties. In the west it is proposed this year to take up three hundred miles of light rails in the Edmonton Grand Bend section, and re-lay with heavy rails.

Trade Notes

The Link Belt Company, Chicago, has just issued "Section A of Catalog No. 110," which contains complete information on Detachable Link-Belt. This company was the first to introduce Detachable Link-Belt to the public and to-day it is its largest manufacturer. The book is well illustrated and covers a wide variety of stock.

The Merritt Hydraulics Company, 112 North Broad Street, Philadelphia, have published a particularly instructive book on Sewer Flushing containing an appendix on sewer pumping, sewer disposal and sewer jointing. The purpose of the authors has been to bring together the results of experience and experiment, and the statements of authorities regarding such important items as the conditions under which deposits will form in a sewer system and flushing will be needed, the amount of flushing water required, the effectiveness of a flush wave, and the frequency of flushing. The methods of flushing and their cost are detailed, and a number of pages are devoted to the theory and design of flush tanks and siphons. A description of the various types of Merritt Automatic and semi-Automatic Flush Tanks and a chapter on the selection of the Flush tank are also given.

The Ric-wiL Underground Pipe Covering Company of 666 New England Building, Cleveland, O., has just issued a new catalog of its underground conduits for steam pipes under the title of the "Ric-wiL Method." The "Ric-wiL" products are illustrated and described in detail, the most notable among these being perhaps the "Ric-wiL" vitrified tile conduit with patented interlocking base drain. This conduit consists of a salt-glazed vitrified tile, lined with a mineral insulation, the tile used being made from Akron shale thoroughly ground and mixed, free from foreign substances injurious to a first-class finished product, and which will withstand perfectly the heat necessary for vitrification. All the sections are salt-glazed, inside and out, and the process is so thorough that the tile is made absolutely waterproof. The inside surface of the tile is serrated or grooved to assist in holding the insulation in place. The insulating material inside the tile is a mixture, consisting mostly of Diatomite, sometimes called "infusorial earth," and used for insulation for the past fifty years in Europe, where it is known by the name of "Kieselguhr." Diatomite consists of microscopically minute forms of practically pure silica, made up chiefly of innumerable skeletons of diatoms containing air cells. When viewed under a powerful microscope it shows various-shaped minute hollow bodies, each one entrapping some air, which gives it its great insulating efficiency. The base drain is made of the same material as the conduit tile. The catalog contains much information of interest to heating men. It can be obtained from the manufacturers upon request.

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Alphabetical Index of Advertisers
Page 16

Vol. 28 July 8, 1914 **No. 27**

Principal Contents

Canadian Constructional Centres—A Criticism 857
A Novel Water Filtration Plant for Toronto 859
The Steam Shovel 859
By Ralph Bacon
Field Notes on Saw-Tooth Concrete Roof Construction at Windsor, Ont. 860-1
Constructional Features of the Salmon River Hydro-Electric Development 862-4
City Engineers' Office Methods 864
The Evolution of a Business Street 865
Explosive Gases in Sewers, and Precautionary Methods 866-7
By G. J. White
The Use of Hydrated Lime in Concrete Mixtures for Pavements 868-70
Analysis of Factory Building Costs 870
Ventilation—Artificial or Natural 871-2
By Paul W. Goldsbury
The Foundation Problem in Building Construction.. 873-4
Safeguarding Buildings Against Fire 875-6
Curious Building Laws of Ancient Times 877-8
Underground-Conduit Developments in Montreal 878
Personal Mention 879-81
(Featuring Messrs. Bion J. Arnold, J. W. Evans, Brydone-Jack and Richardson Builders, Limited.
Vancouver and Coast Correspondence 882-4
Constructional News 884-5
Coming Events 886

Canadian Constructional Centres —A Criticism

ONE of our correspondents favors us with a few acceptable, if somewhat belated, remarks upon the feature "Canadian Constructional Centres" which appeared recently in our columns. His communication is certainly complimentary in so far as what he kindly terms our enterprise is concerned; but his strictures upon certain cities and communities are couched in terms which would scarcely warrant us in publishing them in the original. He expresses the hope that the article will now become an annual feature of the Contract Record, and we certainly have every belief that his desire will be gratified. The response to our request for particulars was a surprising one, and at the risk of repetition we must place upon record our appreciation of the courtesy extended to us by city engineers and city clerks. Without it, the article could never have appeared.

Sewage Disposal

"Sewage disposal," says our candid friend, "seems to be a misnomer as far as Canada is concerned, since, with the exception of quite a few cities, the sewage runs untreated into the nearest river or harbor. Whether this happens above or below the intake for water supply is a serious question which seems to have escaped the observation of your correspondents. Anyway, they are but few that have taken the trouble to give information upon it. Extensions to the sewerage system seem plentifully contemplated, but disposal works are woefully lacking. Surely, the one should imply the other. What a happy phrase, too, is that of 'sewage disposal by dilution'! It embraces quite a multitude of shortcomings. Taking the sewers themselves, now, has not the time come when wooden pipes should be dispensed with? There is clay and enough in the country, and properly vitrified and glazed pipes last for ever. On the score of economy alone, the sanitary article should be used. All cities are not of the whirlwind type." Really, were it not for our correspondent's very distinctive address, we should be disposed to acquit him of any knowledge at all of Canadian conditions. Towns grow and grow rapidly, but there is all the difference in the world between running up a hundred or two houses and installing a system of sewerage and sewage disposal. Festina lente must be the guiding motto of new centres of population. Hastily hatched schemes result only too often in failure and a waste of public money. Townships "travel," and the earliest buildings may form merely a suburb when the city stage has been arrived at. Until the broad lines of the embryo city are laid out, it is unwise to let expensive schemes go much further than the discussion stage.

Sewerage Systems

One important matter in connection with sewage disposal has strangely enough entirely escaped the notice of our correspondent, and that is the prevalence in the Dominion of the combined system of drainage. A complete separate system is not to be looked for, even in the largest cities, but some approach to it is necessary if sewage purification works are to be installed. The wide variations in the flow of sewage with a combined system preclude effective treatment, unless works of an unnecessarily lavish nature are laid down. When pumping must be resorted to, the situation is aggravated. It is usual now, in works laid out upon scientific lines, to provide purification plant and pumping apparatus for six times the dry weather flow, allowing any surplus to run past the works. Such a standard is, we consider, unnecessarily high for universal application in the case of Canadian townships. Where works may be laid down in quite isolated situations, only bare requirements need be considered, so long as the works are constructed with a view to future extensions. The separate is the only "bare requirement" system, and while its adoption is simple (if a little more expensive) in the case of new towns, conversions to it from a combined system will be a costly and a difficult matter. It seems to us then regrettable that for lack of a little forethought scores of growing towns are being saddled with a system that must enormously increase the cost of the sewage works ultimately to be provided, and that will in many cases retard their provision, simply owing to the extensive plant that will have to be laid down.

Refuse Dumping

Considerations of space compel us now to return to our correspondent's letter from which we have somewhat side-tracked. "Disposal by incineration!" he apostrophizes. "What a euphemism for a bonfire! It makes one gasp too to read of the large number of cases of garbage dumping, of the few cases of contemplated destructors, and of the isolated ones of a real live working incinerator. Over and over again comes the stereotyped phrase 'the garbage is deposited on dumps,' or 'the garbage is burned at a dump,' both systems being execrable in the highest degree. A 'nuisance ground' is a most appropriate term and speaks volumes. Pure and simple dumping means trouble and disease for succeeding generations, and a burning dump is but little better. Thorough incineration is never attained, and it does not, like a destructor, reduce the whole of the town refuse to a clinker. Refuse collection should imply the provision of a proper and sufficient garbage incinerator, even in the case of the smallest township." Here again a lack of knowledge of Canadian conditions seemed at first sight to reveal itself, but, continues our correspondent: "Precisely the same rule should apply to every civilized community. Obviously, there is no need for refuse collection in country places and among scattered communities established in what they are pleased to style towns. Householders in such places can, with but little trouble, dispose of their own refuse, either by burning or burying; but if the swelled heads of the ratepayers decide on the necessity for a collection then they should be compelled to dump without nuisance to present or future generations, and that can only be done by dumping straight from the carts on to a destructor feed plate."

Highway Works

Roads next receive the attention of our correspondent; and the painstaking way in which he has gone through the Constructional Centres articles is shown in the fact that he details twenty-nine materials for road construction that he came across in the various reports. The amount of money that is allocated for early expenditure on road work is satisfactory to him, and we gladly note that he "appreciates the difficulties which highway engineers have to contend with in Canada." In any future reports of the kind, he says, "it would be as well more intelligently to classify roads. An earth road is not a road, and it is doubtful whether a plank road is more than a plankway, similar somewhat to a scaffold run. Of one town with a population of 6,000, it is said 'all the roads are earth.' I would venture to substitute the statement with 'there are no roads in the town.' A road implies construction of some kind, and the fact that two rows of buildings are erected at a distance of 20 or 30 feet from each other does not necessarily mean that the intervening space is a road, any more than a plot of scrubby land fenced off at the back or side of a house is a garden. 'Macadam roadway,' too, is a term open to misconception, and capable of application to any road having a layer of stones spread upon it." On the whole our correspondent is satisfied that real interest is being taken in the provision of good roads, and he is content to leave it at that.

On the subject of water supply and lighting he has much to say, but none of it is of sufficient importance to warrant the allotment of space to it. On the former he would like a lot more definite information, pointing out that a statement such as "the water is supplied by a well" or "the water is pumped from the river" may mean that the community are drinking diluted sewage. We would point out, however, that it may just as well mean precisely the reverse, and we are not disposed to give prominence to any of the individual allegations he makes until we have before us the evidence of the other side. Generally, there is a goodly substratum of common sense in what he says, and his illustrations are apt and forcible; but his pen is too prone to outrun his discretion. As we have said, too, he does not appear to have got the hang of Canadian life and conditions. The rapid increase in population which is so marked a feature in so many cities—Saskatoon, for example, and Calgary—seems to have escaped his observation. Large public utility services cannot be installed in a month or two, and even if they could the question of dollars has no slight bearing upon the matter. Still, we thank our correspondent for his criticism, which, although of the destructive rather than the constructive order, was welcome and has been duly appreciated.

Contract Reform

A number of interesting comments upon the article, "Important Aspects of Contract Reform" (Contract Record, June 24), have been received. In a number of cases our correspondents express almost entire agreement with the arguments adduced by this journal, but some observations of additional interest are made by a Hamilton contracting firm who write us as follows:

"Contract reform is a subject which has received well-merited attention in the Contract Record, but there is still plenty of scope, not only for arguments but for work. We conduct general contracting operations on quite an extended scale and we can say that as a rule we are not handicapped by any lack of co-operation on the part of the architect or the engineer. We have heard it said that 'graft' is an appreciable factor in the business, but it must be declining, for we never experience the necessity of grafting measures. In our opinion the deposits required are not excessive. We think that a fair-sized deposit tends to eliminate undesirable competition and bring together contractors of the same class, keeping out those lacking in experience or capital. As to the principle of the lowest bid, there is no doubt that contracting is affected adversely by it, but we do not see what remedial measures can be taken when tenders are called for in good faith. When awarding sub-contracts, we, ourselves, make it a practice to invite bids from only those concerns to whom we would give the business, and almost invariably we award the contract to the firm submitting the best proposal. On the other hand, it is not our experience that low bids and incompetency go hand in hand. We have seen many a good contractor submit too low a bid and have to fulfil the specification and pocket his loss in the event of there being no change of conditions in his favor during the progress of the work. If an ignorant, inexperienced contractor, or one lacking in financial strength, submits a figure that is altogether too low, he should be disqualified—in the interests of the undertaking. Any other policy means trouble for the owner, the engineer, the sub-contractors and the material man. Possibly a thorough re-organization of the contracting interests might help the work of contract reform, but whence such reorganization?"

British Trade in Canada

Commenting upon the editorial article, "British Trade in Canada," published in our issue of June 17, an eastern contracting firm writes us:

"Your article brings out a number of interesting points, but we should like to add a word or two on the score of delivery. The great difficulty is that British firms have so much work on hand that their deliveries suffer, and consequently the importer of English goods is placed at a great disadvantage, delivery being one of the first things taken into consideration by Canadian firms. As a rule, old country firms are slow to appreciate the difference in conditions and they do not like the extended credit which is necessary for any firm doing business in Canada. British-made machinery and other supplies are second to none in quality and the prices compare favorably with those of their competitors on this side of the Atlantic. If the manufacturers of the British Isles will but take the trouble to study Canadian conditions and adapt themselves to Canadian requirements, the volume of trade will increase tremendously in the next few years."

A Novel Water-Filtration Plant for Toronto

(The Engineering News)

It is not often that a city takes up a novelty in water filtration or in any other class of engineering work on so large a scale as the proposed 72,000 U. S.-gal. "drifting-sand" filtration plant for which the city council of Toronto awarded the contract on June 8. It is true that two plants of a few hundred thousand gallons capacity are already in operation elsewhere and that contracts for two other and much larger plants are well under way. It is also true that a working unit was tested for 33 days at Toronto under the direction of the local medical officer of health and city analyst, and that this same test plant has been under observation for over a year. Nevertheless, the fact remains that the drifting-sand filter is as yet in the working-scale experimental stage, with few data yet available regarding its efficiency and less to be had regarding operating costs.

The drifting-sand filter may be described as a deep mechanical filter with reversion to the early type in the way of absence of coagulation basins and rate-controllers and with the addition of continuous washing and replacing of filter sand. It is claimed that this added feature makes up for the lack of a coagulating basin. To what extent this claim will be made good by experience at Toronto and on different waters at other places, it will be interesting to learn a few years hence.

Those who have followed the history of mechanical filtration will remember that the basic patent for the process was upheld very largely on the claim that the process obviated all need for precoagulation, but that as the years have gone by precoagulation has come to be regarded as more and more essential. In much the same way, new types of sewage filters, at first held to be all-sufficient, have been found by experience to yield a better effluent at less cost when pretreatment and in some cases after-treatment was employed. In other words, up to this time a vast body of experience has proved that as a rule some lightening of the burden on both water and sewage filters is desirable. The broadest exception to this rule is when water filters, and particularly slow sand filters, treat relatively clear and colorless water. In so far as the Toronto

The Steam Shovel

By Ralph Bacon

I am master of earth, and my glad heart sings,
As backward and forward my bucket swings.
I lift up the tons of rock and sand,
And I pour them into the cars that stand
Patient and still with their mouths held wide.
When I fill them up they go satisfied
Off to the dam, the levee or the road,
Or to build up a swamp for a city's abode.
I never am weary; my arm of steel
Labors for joy; I am glad to feel
The great earth trying to hold the clay
That my titan strength keeps tearing away.

Oh, I am king of the digging crew!
Can a hundred men do the work I do?
Can they work all day, and then all night,
Without sleeping a wink or eating a bite?
Can they work a month on a drink of oil
In the arctic blast or the tropic broil?
No men can do the things I do,
For I am king of the digging crew!

The railroads follow where I make way;
I join the rivers; I curb the bay;
I bring the waters from highlands down
To the barren valley and thirsting town;
I level the heights and gorge the fills;
I bring the power to the mighty mills;
When I come to a mountain, I cut it through,
For I am king of the digging crew!

Down on the Isthmus of Panama
I was the will, I was the law!
I am the monster the mountains dread;
When the sun beats down and men drop dead,
I sink my teeth in the hard red clay
And sing as I tear the earth away;
And I laugh as I let the oceans through,
For I am king of the digging crew!

When man conquers the land, he lays it waste;
When I conquer the land, canals are traced
Across its deserts that straightway fling
Over themselves the garments of spring.
If I boast, it is only of things I do,
Of the peace and plenty I bring to you,
For I am king of the digging crew!

water falls in this class precoagulation may be unnecessary, even for mechanical filters. As has already been stated, it is claimed for the drifting-sand filter that precoagulation is not required.

The foregoing illustrations do not prove and are not intended to prove that the drifting-sand filter is not going to be a great advance in filtration. They do raise questions as to its rendering precoagulation unnecessary, and to the experienced will suggest various other questions regarding these filters which must yet be settled.

A city less venturesome than Toronto would probably have deferred awarding so large a contract for a new type of filter until it had been tested under the direction of consulting engineers. Such tests might well have included the standard type of mechanical filter, operated with and without precoagulation, and they might also have included slow sand filters, the whole dealing with the same raw water. As events have proven, no time need have been lost by the more comprehensive tests, since over a year has gone by since the tests on the drifting-sand filters were begun.

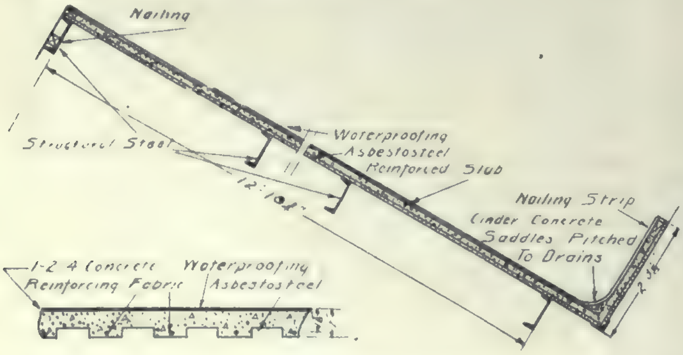
However, the city authorities of Toronto did not adopt the new filters until after a test under the direction of local officials and a long period of observation. They have the assurance that the engineering details of the proposed plant have been worked out with great care by the engineers.

Other cities will have reason to thank Toronto for having the courage of its convictions to the extent of constructing a large example of this new and interesting type of water filtration plant.

Field Notes on Saw-Tooth Concrete Roof Construction at Windsor, Ont.

An interesting example of light concrete roof construction has just been completed at the new building for the Remington Arms-Union Metallic Cartridge Company, Windsor, Ont., Canada. The general construction of the building is the saw-tooth type, the slope of the separate roofs being 30 deg. There are nine sections, six of which are about 150 ft. long, and three 50 ft. long. The skeleton work of the building is of steel with the roof trusses carried on plate girders spanning columns about 50 ft. o. c.

The roof in general was constructed of 24-ga. Asbesto-steel, covered by a smooth concrete slab about 1½-in. thick, in which was embedded a wire mesh of mild steel, the mesh being fastened to the bottom of each corrugation of the sheets by special clips, thus insuring the position of the wire at the bottom of the slab and giving a roof of maximum strength.



Structural details showing the arrangement of the asbestos steel, concrete slab, structural purlins and gutter details.

The steel sheets are of open-hearth steel covered on both sides with asphalt and white asbestos and present a very attractive appearance as an interior ceiling for the building. There was no necessity for plastering the under side. It is claimed that the asbestos covering and asphalt binder give a highly insulated roof. The corrugations of the sheets are about ¾-in. deep and about 2⅜-in. wide.

The erection of the sheets was simple and required but two men to handle the material on the roof and a laborer on the ground who raised the sheets to the men and who also placed the clips for attaching the reinforcing mesh on the sheets before they were raised. Special purlin clips were furnished for fastening the sheets to the roof purlins in such a manner that the fasteners were not visible from the under side. In the same manner the sidelaps of the sheets were fastened to form a continuous joint in the corrugations and did not destroy the uniform appearance of the under side of the roofing sheets.

The erection of the roofing sheets was completed just about the same time as the brick parapet walls were carried up to the roof line and the concrete work started immediately. A serious problem of preventing this very thin slab of concrete from freezing had to be taken care of at this time, as the temperature was very low.

Equipment and Plant Arrangement

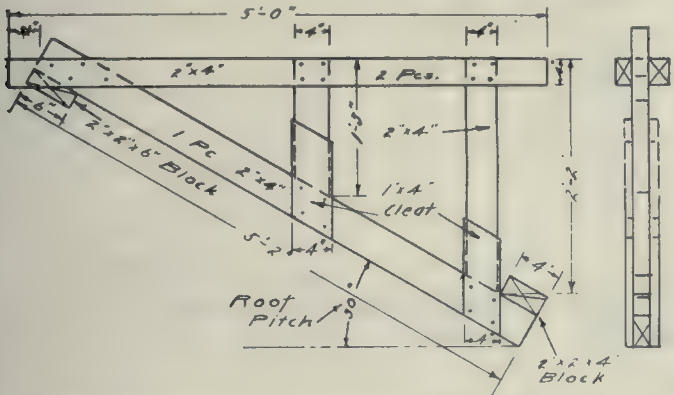
A 1-3-cu. yd. mixer connected to a steam engine with a 10 h.p. boiler, was used for mixing all the concrete. Hot water was obtained from this boiler to wash the snow and ice from the sheets. A steam line was also run from this boiler to heat the sand pile. Three 1-in. pipes were carried under the sand pile, the pipes being perforated to allow the steam to escape. The steam pressure was kept up all night, a night watchman taking care of the fire, and the steam was allowed to escape into the sand pile all the time.

The mixer and the tower were located at about the centre of the south wall. The tower was built of 2 x 4's spiked together to form 4-in. x 4-in. corner posts and 1-in. boards for braces. This tower was about 40 ft. high. The cage was made large enough to carry one wheelbarrow. A horse was used to raise the material. A counter-weight which was hung on the rope which passed over the sheaves on the top head frame and the bottom foot block assisted materially in decreasing the load the horse had to lift. A curious fact was that the horse had no difficulty in raising the load but seemed frightened when the cage was lowered, and the load of this cage pulled him back. A hook made of ¼-in. band iron hung from the head frame and was swung under the cage as it reached the top, thus taking the load away from the horse and insuring against danger while the full wheelbarrows were unloaded and the empty ones sent down.

A central runway about 5 ft. wide was constructed, crossing at right angles the stretches of saw-tooth gables, and the concrete was delivered to each section of the roof from this runway. Small triangular horses (which are shown in the sketches) were made on the ground, and these were used to support the plank runways. They were easily put in position and were shifted from one section of the roof as it was concreted to the next one with very little labor and loss of time. In fact, the concreting proceeded continuously without any necessity for stopping to shift the scaffold. The horses were made so that they hooked over the top purlin and the bottom end rested on the purlin below, thus taking all the load off the sheets and slabs.

Placing the Concrete Roof Slab

In placing the concrete, screeds were nailed to the sheets about 8 ft. o. c., and these screeds were left in the concrete slab to serve as nailing strips for the waterproofing. Dry concrete was first placed in the gutters the entire length of the section and then the slab was poured and the gutter finished at the same time. On account of the steep pitch the consistency of the concrete was very dry. The surface was floated to a smooth finish.



Detail showing the construction of the triangular runway horses.

As an added precaution against freezing the concrete was also protected after it was poured. Large salamanders were placed in the room below and tarpaulins were hung from the roof trusses to confine the heat at the portion of the roof at which the concrete was being poured. The ends of the saw-tooth sections were boarded up and all over the roof 1-in. boards were placed, on top of which were laid bags filled with manure. In this way the roof was protected against cold from all possible directions. The handling of the manure in this way proved very expeditious and also eliminated dirt and loss of material which would have resulted if the manure had been placed loose on the roof.

The ventilators shown on the building were bolted to the sheets before the concrete was poured and the metal of the asbestos sheets cut out for the round openings at the same time the sheets were erected.

The work was interrupted several days on account of snow. However, by employing a large gang of laborers and cement finishers, the concrete was all poured within 8 days after starting.

A standard built-up waterproofing was installed and the flashings at the parapet walls and at the ridges were the standard asbestos protected material used for flashing purposes.

All of the erection of sheets and placing of the concrete was performed by the Asbestos Protected Metal Company, Beaver Falls, Pa., under the supervision of Meyer Davis, this firm's engineer representative. —Concrete Cement Age.

The Quantity System

Some of the advantages of the quantity system of estimating, as enumerated by G. Alexander Wright, of San Francisco, are as follows:

1. Saving of time and money.
2. Greater precision in measuring.
3. No uncertainty as to interpretation of plans or specifications (the quantities should govern).
4. No visits to the architect's office when figuring, for explanations or otherwise.
5. No other work is contracted for except the quantity set forth in the quantities.
6. The contractor, if he so desires, can check up the quantities before signing a contract.
7. No bidder can inadvertently leave out anything, and so in this way arrive at too low a figure.
8. No having to spend time taking out his quantities, the contractor has time to attend to more profitable business.
9. Systematically arranged bills of quantities duly priced (whether work has been secured or not) form excellent data for making future estimates.

A remarkable example of reinforced concrete applied to architecture is to be seen in a building now nearing completion in Paris. The structure is a block of flats of six storeys in the Avenue Bugeaud, where the Metropolitan Railway of Paris passes under the roadway, and the ocupants of houses facing the street suffer considerable inconvenience from the vibration of passing trains. In order to avoid trouble of the kind in the new building, the architect decided to isolate it entirely by supporting the entire structure on a series of seventeen ferro-concrete stilts, or columns, carried down to a stratum of solid rock, at a depth of about 60 ft. below the surface. Each column is contained in a shaft, and rises from bedrock to street level without touching the sides, and the columns support a framework of girders on which the building is constructed. A small space is left on either side between it and the houses on each side of it, and the facade is separated from the roadway by a sort of mattress of steel springs. Thus, the building stands practically clear of everything around it, the foundations touching nothing but the bedrock from which they rise. It is stated that this novel method of construction has proved entirely successful as regards the prevention of vibration.

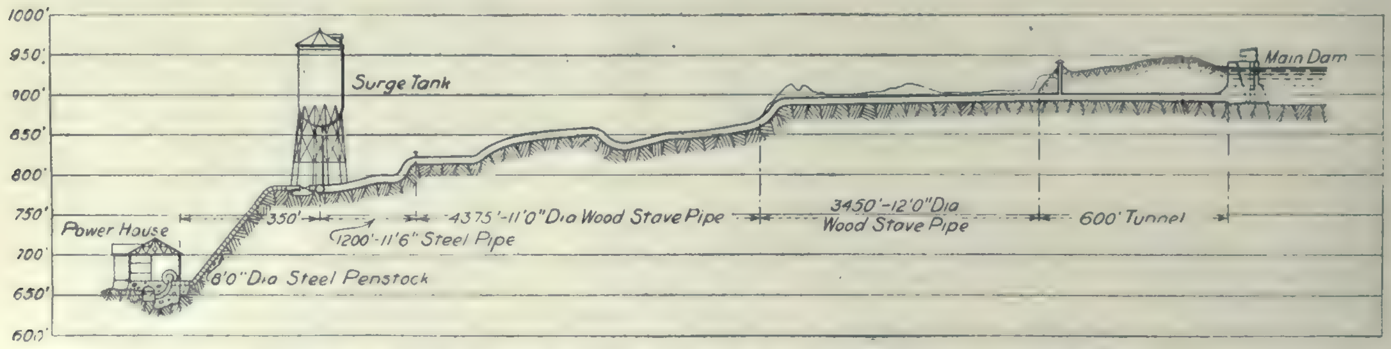
An ingenious analytical method for estimating substances susceptible of precipitation from liquids has been invented by M. Dienert, chief engineer of the City of Paris water supply, by combining the calorimetric process of Dubosc with the projection lantern. By comparing in the two halves of the field a liquid containing matter in suspension and a standard liquid, it is easy to see if the colouration is the same. The method is applied to the estimation of matters contained in natural waters, and only requires 20 to 30 cubic centimetres of water for each analysis. It is stated to be as exact as the usual methods.

A well-designed reinforced concrete structure, as pointed out by Ferro-Concrete, is actually jointless. Therefore, a load concentrated on one portion of a building is distributed over a large area of the surrounding structural members and any local tendency of a building to settle is resisted, not by the parts locally affected, but by the structure as a whole.

Constructional Features of the Salmon River Hydro-Electric Development

A Central New York Plant Operating in Parallel With the Ontario Power Company's Niagara Falls Plant

The new hydro-electric plant of the Salmon River Power Company, which comprises a development of 30,000 h.p., operating under a head of 245 feet, has many points of constructional interest. The Salmon River flows from the foothills of the Adirondacks in a westerly direction through the northern part of New York State into the eastern end of Lake Ontario. While the length of the stream is only 44 miles, it drains a watershed remarkable from the hydraulic standpoint in that over a tributary area of 190 square miles there is an average annual rainfall of about 60 in. In addition, the river falls 650 ft. in the 17 miles between Stillwater and the lake and more than 400 feet in a distance of less than eight miles. At Salmon Falls the drop is 110 feet. While the flow of the stream is somewhat irregular, the valley above the Salmon Falls is of a form suitable for storage purposes. Moreover, the location of the site is such as to enable the power company to dispose of the entire output of the plant to the Niagara, Lockport & Ontario Power Company, which has leased the property in perpetuity and acquired all its capital stock. The latter company draws its supply at present from the plant of the Ontario Power Company at Niagara Falls and from its own steam plant at Lyons and Auburn. It can utilize the full output of the new plant to advantage in combination with the other three.



Elevation of the Salmon River hydro-electric development, showing the relation of its various structures.

From the hydraulic standpoint the features of interest are the concrete dam and spillway situated near Stillwater, the artificial lake about eight miles in length and 5½ square miles in area, impounded by it, the 2-mile conduit of wood-stave and steel pipe, the distributer in which the conduit terminates, the enormous and novel surge tank, the Johnson valves in the penstocks, the penstocks themselves, the turbines and their governors, and finally the tailrace. With the aid of the illustrations a comprehensive view of these parts of the installation can be readily obtained and only the salient features need special description.

The Salmon River is of the kind found all through the lake district of central New York. The riverbed is at the bottom of a narrow valley with rather steep hills rising on both sides. At places the valley widens considerably, as, for example, just above Salmon Falls; at others it narrows into a gorge with steep banks, as at Stillwater. By the location of a dam at the latter point with a crest at an elevation of 935 a large area was submerged with little loss of property, as the valley is sparsely settled. Only a dozen or so of dwellings, including several on the edge of the village of Redfield, and a few miles of highway had to be relocated. The height of the dam crest is limited to about 935 unless more extensive dikes are built to prevent diversion of the water into the watershed of the streams draining into Oneida Lake, several of which take their rise on the south side of a narrow ridge which parallels the Salmon River closely on the south.

The artificial lake has a capacity of 2,600,000,000 cu. ft. with the dam crest at 935, and, at the average rate of flow of the stream, about twenty days are required to fill it. With the crest at this height the average net head produced at the power house less than 2 miles away is 245 ft.

The present temporary crest is at elevation 924, but during the present year it will be raised to elevation 935. Keyways are provided in the temporary spillway to tie the future concrete cap to the present structure, the crest being temporarily formed with a wooden apron. On the down-stream face of the dam is a 25-h.p. Pelton wheel for the gate drive, connected by long shafting and bevel gearing to a longitudinal shaft in the gatehouse. By means of clutches the gate-raising mechanism is connected to this shaft.

The conduit connecting the dam and the power house consists of five sections, a 600-ft. reinforced concrete-lined tunnel drilled through rock, a 7,825-ft. length of wood-stave pipe, a 1,200-ft. length of steel pipe, a steel distributer and four short penstocks. The topography of the country between the dam and the power hopse, which is situated at Bennett Bridge, is such that an open canal could have been used. The pipe line, however, was found to be cheaper.

The tunnel was necessary at the dam end of the line to pierce the southerly ridge previously referred to. It is lined with concrete not less than a foot in thickness with circumferential reinforcing rods closely spaced, and it has an inside diameter of 12 ft. The wood-stave pipe continues at the same diameter for

3,450 ft., the diameter being reduced to 11 ft. for 4,375 ft. more. The staves are of kiln-dried Douglas fir cut not less than 3⅝ in. thick for the 12-ft. pipe and 4 in. for the other. They are joined end to end by means of galvanized-iron keys and are held circumferentially with bands of ⅞-in. and 1-in. steel rods. Each band is in three sections, all united by cast-iron clamps. In soft ground the pipe was supported on timber cradles, but otherwise it was laid directly in the surface. It was coated on the outside with Avenarius Carbolineum and afterward back-filled to about one-half its height. Relief valves were inserted at intervals to prevent undue pressure when emptying the pipe, and to serve as air outlets when filling, and drains were placed at all low points. The engineers selected wood pipe for that part of the conduit in which the pressure was not too great because, in the cold climate of the region, it is cheaper than steel pipe when the latter is properly protected from freezing. Fir was used because it is an excellent wood for pipe not subjected to alternate wetting and drying in that it remains tight, does not rot and is reasonable in price.

The steel-pipe section is 1,200 ft. in length and 11½ feet in diameter. It is connected to the wood pipe through a slip expansion joint packed with oakum and lead wool. Special attention was given to the material in this pipe, which was specified as open hearth steel containing not over 0.05 per cent. sulphur and between 0.3 and 0.6 per cent. manganese. The phosphorus was limited to 0.06 per cent. if the steel was made by the acid process and 0.04 per cent. if by the basic process. The thickness of the pipe is ⅝ in. throughout. The steel pipe was mounted on concrete saddles 20 in. thick and spaced about 14 ft. apart. It was laid in a shallow well-drained trench and a 6-in. sewer tile was molded in the bottom of each saddle to facilitate drainage. The pipe was housed over with a substantial structure of framing and boarding continued down to the ground level. The roof, of 1-in. boards, was covered with a layer of roofing paper. Trap doors were placed in the roof over all manholes.

From Distributer to Tailrace

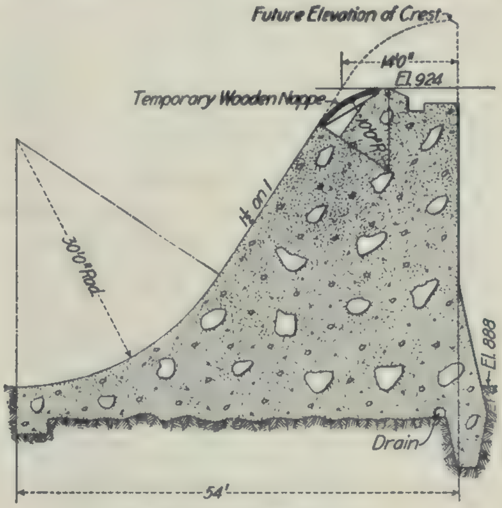
The more novel features of this plant are found in and near the power house. On the crest of the ridge just behind are not only the most conspicuous but also the most original elements of the hydraulic equipment. First there is the distributer, a 12-ft. steel pipe 210 ft. in length and joined at one end to the pipe line in a huge concrete anchor block. The other end is closed by a bulkhead. The elevation of the bottom of the distributer is 775 feet, or 160 feet below the crest of the dam.

From the center of the distributer a 12-ft. riser branches off to a surge tank. This enormous T-connection requires reinforcing from side to side, and this is provided by a 9-in. bolt, 25 ft. long, with bearing washers for the nuts 4 ft. in diameter. The surge-tank riser joins the distributer with easy curves, but a novel and cheaper connection is made to the penstock intakes, 8 ft. in diameter. This is a simple flanged and riveted joint, which would, without some modification, produce eddies and loss of head. To prevent such, wooden fillers suitably rounded off are secured around the mouths of the intakes inside the distributer.

The distributer is a steel pipe, ⅝ in. thick, inclosed in concrete.

The surge tank, built by the Kennicott Company of Chicago Heights, Ill., is the largest of its type yet constructed. It consists of a cylindrical shell, 50 ft. in diameter and 80 ft. high, surmounting a hemispherical bottom which adds 25 ft. to the height. Its capacity is, therefore, 1,400,000 gal. The tank is supported on ten columns with heavy concrete footings. It and the riser are housed in with a framed wooden structure providing a surrounding air space which can be heated when necessary from a small house below. The top of the roof of this structure is 205 ft. above the ground, and the top of the tank is high enough above the crest of the dam so that if the flow of the water in the pipe line were suddenly interrupted its energy would be absorbed by the rise in level in the tank without overflow.

An important feature of the surge-tank riser remains to be mentioned. With a 12-ft. riser opening into the bottom of the tank there would not be friction enough to absorb the energy of a surge, which would therefore tend to set up oscillations. To provide for the damping of such oscillations, a smaller pipe is mounted inside the tank, connected directly to the riser below and terminating in a funnel near the top. The rest of the mouth of the riser at the bottom of the tank is covered by a ring in which small ports are provided. In action, therefore, a surge produces a rise in the small pipe and some flow through the ports. The head in the small pipe then forces the surplus water through the ports and equalizes the pressure gradually. This process is technically termed "differential action" and is an invention of the hydraulic engineer of the Ontario Power Company, Mr. R. D. Johnson.



Cross-sectional elevation of dam.

The four 8-ft. penstocks are connected to the intakes through valves of a type which represent a comparatively new development in hydraulic practice. They operate under a head of nearly 154 ft. The type of valve used is also the invention of Mr. Johnson, manufactured by the Wellman-Seaver-Morgan Company.

Below the valve houses are the four 8-ft. penstocks, anchored above and below in heavy concrete blocks, and laid in trenches and entirely back-filled. The steel plates vary in thickness from ½in. on the upper horizontal portion of the penstocks to ⅞ in. at the lower end where they enter the power house.

The 10,000-h.p. Turbines

The four turbines are of the Francis horizontal, single-spiral, double-discharge type of 10,000-h.p. rating each. They are provided with outside, balanced wicket gates operated by Lombard governors. These machines have guaranteed efficiencies of 82 per cent. at full load, 85 at three-quarters load, 80 at half load and 70 at quarter load. The specifications on governing permit not more than 15 per cent. increase in speed above the normal value of 375 r.p.m. on the sudden removal of full load, 6 per cent. for half load, 3 per cent. for quarter load, and 1.5 per cent. for tenth load. The turbines are provided with heavy flywheels to assist in governing and to facilitate the operation of the electrical equipment of the plant in parallel with the Niagara, Lockport & Ontario Power Company's system. The turbines are provided with relief valves operated by the governors, so that the sudden checking of over-speed cannot result in an excessive rise of pressure.

The discharge of the turbines is conducted to the tailrace through short concrete draft tubes, entering at an obtuse angle to prevent eddies. In fact, on its entire journey from reservoir to tailrace the water is led with as few turns as possible and around easy curves. The tailrace is directly under the power house, which is built over the bed of a branch of the river that previously carried water at times of flood and was with little expense transformed into a tailrace. The exit of the tailrace from the building is closed by a curtain wall which prevents the ingress of cold air. The old riverbed, below the building, was cleared out for a distance of several hundred feet, and the banks were reinforced with dry-laid stone walls.

The Power House

The power house is a simple structure consisting of reinforced-concrete pilasters connected with heavy concrete beams. The panels are filled with red brick outside and sand-lime brick inside. The roof, supported on steel trusses, is 3 in. thick, of gypsum composition reinforced with steel cables and rods. This is the Metropolitan Fireproofing Company's system and was installed by the Keystone Fireproofing Company. The roof is covered with an asphalt coating overlaid with several layers of asbestos felt. One purpose in the use of this particular type of roof was to secure a fireproof base to which tile could be nailed in case it was later found desirable to add a tile roof. The gypsum roof is very light and was easy to place.

The building is rectangular with a projecting feeder bay. The interior is open to the roof and, with the exception of a gallery about 12 ft. above the main floor on the feeder-bay side, forms one great room. It is served by a 40-ton Shaw electric crane with main and auxiliary hoist all driven by 250-volt direct-current motors. The crane has a 38-ft. span and the runway covers the entire length of the building.

Coming now to the foundation of the building, the construction already briefly referred to is especially interesting in that the intake pipes, the draft tubes and the discharge tunnel are all directly under the building, embedded in or formed of concrete which rests on solid rock.

Each of the four electrical generating units consists of a 375-r.p.m.,6600-volt, twenty-five-cycle, three-phase generator with exciter mounted on an extension of the shaft; three 2200-kv.a., single-phase, twenty-five-cycle transformers with a normal ratio of 6600 volts to 34,650 volts, with high tension in star, giving 60,000 volts line voltage; a 6600-volt, 1200-amp., triple-pole, single-throw, type "C" oil circuit-breaker, automatic for reverse power, and the necessary connecting cables and auxiliaries. Each unit is thus as nearly self-contained as possible, with all parts placed conveniently near together.

The engineering of the plant has been under the direction of V. G. Converse, chief engineer of the Salmon River Power Company. During the preliminary work and the designing period D. R. Cooper was assistant chief engineer. Most of the hydraulic features were designed by R. D, Johnson, hydraulic engineer, of the Ontario Power Company, and the electrical features by J. A. Johnson, electrical engineer, of the Ontario Power Company. Barclay, Parsons & Klapp had charge of the engineering and construction of the dam and acted as consulting engineers for the entire work. Francis V. Greene is the president of the Niagara, Lockport & Ontario Power Company. The plant was put into operation April 10, 1914. Two units are now in operation and the third and fourth are in process of installation.

City Engineers' Office Methods

THE following data from the recently issued annual report of the Commissioner of Public Works of St. Paul, Minn., give the office methods of a large city engineering office quite succinctly.

Indexing—Card indexes are kept: (a) Of recorded plats; (b) of park plats; (c) of established grades on streets and alleys; (d) of contracts, indexed by street and name of contractor; (e) current index of preliminary and final orders from the Board of Public Works and the letting of contracts thereon; (f) index to all survey notes; (g) graphic index to monuments as established; (h) general index, openings, slopes, sewers, etc., including special and general structures; this is one of the largest and most comprehensive of the indexes, made necessary by the wearing out of the present book system, and is about 90 per cent complete. Full advantage has been taken of numerous opportunities for cross indexing, including the same plat under various heads, such as location, character of work, departments, etc.

Book-keeping—A card-index system of book-keeping was so planned as to serve as a journal and ledger record.

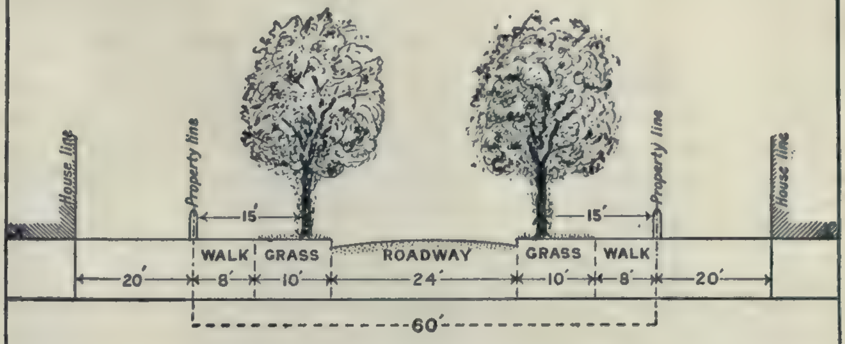
Filing—A card index of field books taken from vault is kept. The clerk in charge of records charges all books against the employee using them, and is able to locate the party having them, giving them credit when records are returned.

The London, Brighton & South Coast Motor Roads Syndicate Company, Limited, is having a bill introduced in the Imperial Parliament to secure sanction for the construction of a highway exclusively confined to automobile traffic. The road-bed proposed is to be of reinforced concrete with a bituminous surface. It will be about 50 miles long and 150 feet wide and will involve an estimated outlay of $25,000,000. The entrance to the highway will be at Richmond and the southern terminal Brighton. Three tracks will be provided, the first being for fast traffic, the second for heavier vehicles, and the third for auto cycles and cycle cars. The plans provide for the erection of an ornamental stone arch and a rectangular building for garages, workshops, etc., near the entrance to the road at Richmond.

Evolution of a Business Street

THE solution of the problem of the congestion that is found in the main streets of towns is to plan residential roadways so that they may be transformed gradually into business streets at a minimum of expense. One way in which this may be done may be understood by a glance at the accompanying illustrations.

COMMISSION OF CONSERVATION



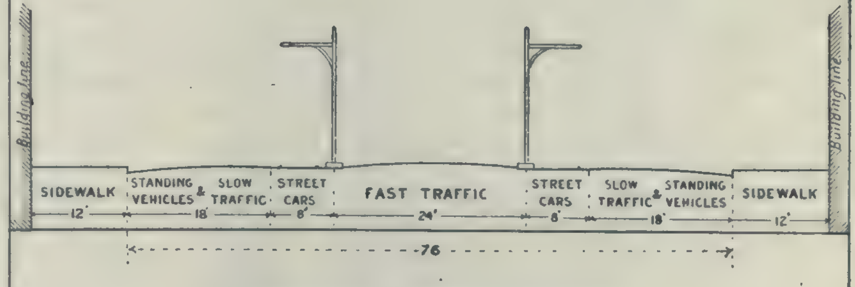
A 60-FOOT STREET

The upper diagram shows a street 60 feet wide and suitable for a residential section. The roadway is of moderate width, sufficient to accommodate the light traffic of delivery wagons, carriages, etc., that serve the houses on either side. A boulevard and trees give it a pleasant appearance, and, also, the houses are set back 20 feet from the property line, with gardens or lawns between them and the sidewalk.

If commercial interests should invade this region, property owners would, under ordinary circumstances, build forward to the sidewalk, partly to use the extra space, but chiefly to bring store windows flush up to the causeway. A portion of the street in process of transformation presents a very ragged appearance, due to the lack of a uniform building line. When the process is complete, the once beautiful residential street has become a congested business thoroughfare with narrow walks and a 44-foot roadway. To widen it would necessitate the tearing down of valuable buildings and would be a heavy expense to the taxpayers.

Foresight would obviate this undesirable development. All that is necessary is to establish a restriction prohibiting the use of land for building beyond an established line. Legally, of course, this involves compensating the property owners, but the damages can be distributed over a long period in a simple way. No property rights need be acquired by the municipality until application is made for a building permit on an obstructive site, and then the restriction can be imposed and paid for. In this way the public thoroughfare is gradually widened at exactly the same rate as the growing commercial interests require. At no time is it necessary to pull down buildings. When any considerable number of property owners require it, the walk may be moved over to the building line and the roadway widened. The trees should be left as long as possible, and, unless a street railway is constructed, should be a permanent feature.

COMMISSION OF CONSERVATION



A 100-FOOT THOROUGHFARE

The lower diagram shows the ultimate development of the 60-foot street into a 100-foot thoroughfare. Safety for pedestrians crossing the wide roadway is provided by "islands" at the base of each pole holding the electric wires. Motor-cars may run up and down the middle unimpeded by slow-moving wagons and drays, while the latter have ample room to pass between the street car tracks and standing vehicles by the sidewalk.

In connection with the above it is interesting to compare the following extract from a recent address by Mr. Raymond Unwin, F.R.I.B.A., before the Victoria League Imperial Health Conference in London: "There are certain requirements of town planning which are fairly obvious and generally applicable, such as the prevention of the overcrowding of dwellings, and the fixing of such a building line on all the main highways radiating out of the town into the country, as will prevent buildings being erected so near to these roads that future widening can only take place at excessive cost after demolition of the buildings."

A bridge which will probably be the third largest in the world as regards length of span, and the first as regards headway for shipping, will be constructed across the harbor of North Sydney, Australia, in conjunction with an underground railway system. The specifications provide for nickel-steel cantilevers supporting centre girders also of nickel-steel. The shore arm of the cantilevers will be about 500 feet long and the cantilever arms 520 feet long, while the length of the centre girder will be about 560 feet. The approaches to the bridge will consist of steel arch spans of the three hinged spandrel braced type.

Explosive Gases in Sewers and Precautionary Methods

By G. J. White*

EXPLOSIONS of gases in sewers, while not of very frequent occurrence, constitute a serious danger to both life and property in cities. A discussion of the various gases which may ordinarily collect in sewerage systems will serve as an introduction to this paper.

GASES FOUND IN SEWERS

Air.—Air consists of approximately 20.96 parts of oxygen, 79.0 nitrogen, 0.04 of carbon dioxide, and other impurities, by volume. It is colorless and odorless. It has a specific gravity of 1, and forms a basis to which the specific gravities of other gases are referred. It is not explosive in itself, but furnishes the oxygen necessary for the explosion of other gases, which by themselves may be non-explosive.

Sewer Gas.—Sewer gas consists of approximately 90 parts of nitrogen, 2 to 4 parts of oxygen, 1 to 3 parts carbon dioxide 3 to 5 parts of carbon monoxide, methane and other gases, by volume. The specific gravity varies with its composition and is approximately 1, or the same as air. It has an odor due to the organic decomposition constantly going on in the sewage with which it is in contact. It is not poisonous in the true sense of the word, but due to its high percentage of nitrogen and low percentage of oxygen, it will not furnish a sufficient amount of oxygen to support respiration, and hence a person is slowly smothered in an atmosphere of this gas. It is non-explosive in itself and, due to its high nitrogen and low oxygen content, would undoubtedly prevent the explosion of otherwise explosive gas when mixed with it, unless some other gas such as air were added to furnish the necessary ogygen for the combustion.

Coal Gas.—Coal gas is made by the destructive distillation of high-volatile coal in clay products. Its composition varies with the kind of coal used and the details of manufacture. It consists of approximately 3 parts of illuminants (ethylene, etc., of the C_nH_{2n} group), 35 to 40 parts of marsh gas, 45 to 50 parts oxygen, 1 to 2 parts carbon dioxide and 3 to 5 parts nitrogen, by volume. It is colorless, but has a very strong penetrating odor, so that a smell percentage of coal gas mixed with air may be readily detected by the sense of smell. In itself, it is not explosive, and must be mixed with air or some other gas which will furnish the necessary oxygen for combustion. A cubic foot of ordinary coal gas requires 1.21 cu. ft. of oxygen, more or less, due to the variations in the constituents of the gas, for complete combustion. If we allow 20 per cent. of oxygen in the air, then for complete combustion $1.21 \times 5 = 6.05$ cu. ft. of air is necessary to furnish the oxygen for the combustion of 1 cu. ft. of gas. An explosion will take place with mixtures of from 4 to 12 parts of air with one part of coal gas, the intensity of the explosion varying with the mixture. The specific gravity of coal gas varies with its composition from 0.50 to 0.60, or it is about one-half times as heavy as air.

Water Gas.—Water gas is made by passing steam through a bed of incandescent carbon. Water gas thus made would have a comparatively low heating value and relatively small candle power. Therefore, it is enriched by spraying volatile oils on pure water gas while passing through towers filled with checker-work brick, which are heated to incandescence. The composition of water gas varies with the details of manufacture. Water gas is composed of approximately 25% carbon monoxide, 10% illuminants, 30% of hydrogen, 1% oxygen, 3% carbon dioxide, 25% methane and 6% nitrogen by volume. It is non-explosive in itself and must be mixed with air or some other gas which will furnish the oxygen necessary for combustion. It has approximately the same explosion range as coal gas. It is extremely poisonous, due to its high carbon-monoxide content. It has a penetrating odor, even more noticeable than that of coal gas. The specific gravity of water gas varies from 0.45 to 0.55 with its composition.

Coke-Oven or Solvay Gas.—Coke-oven or Solvay gas, like coal gas, is made by the destructive distillation of coal in ovens. In coal-gas manufacture, the gas is the main product, while coke is a secondary or residual product. In coke-oven gas manufacture, the coke is the main product and the gas is a secondary or residual product. The composition of Solvay gas is similar to that of coal gas. Like coal gas, it is colorless and has a penetrating odor. Like coal gas, it is non-explosive in itself, but becomes explosive when mixed with various quantities of air. The range and the intensity of the explosion are approximately the same as those of coal gas.

Illuminating Gas or City Gas.—Illuminating gas or city gas as generally distributed, may be coal gas, water gas, Solvay gas, or a mixture of any two or all of these gases. It is colorless and has a strong penetrating odor. Gas fitters can detect a leak in a gas fixture, by the sense of smell, that will not light. It has ordinarily a specific gravity of 0.50 to 0.60 or about one-half that of air. It is non-explosive in itself, and will explode only when mixed with 4 to 12 volumes of air. City gas stored in a gas holder would not explode if the holder were struck with lightning. If the tank was ruptured sufficiently to let any large amount of gas escape, there would simply be a flash similar to that following the throwing of a lighted match into an open barrel of gunpowder. I have seen workmen mark leaks on a gas holder by igniting the gas issuing from the holes.

Gasoline.—Gasoline of the American trade varies somewhat in its specific gravity from 0.70 to 0.74 as measured by the Beaume scale. 0.70 is a light grade, and 0.74 is termed stove gasoline from its general use for heating. The analysis of the 0.71 gravity gives carbon 838; hydrogen, 155; inpurities, 7 in 1,000 parts, with a heating value of about 18,000 B.t.u. per lb. The variation of the gravity of gasoline is due to the variation in the percentage of hydrogen. The vapor of gasoline is equal to 160 cu. ft. per gal., or about 1,200 times its liquid bulk. A saturated air gas of equal parts air and vapor equals 320 cu. ft. per gal. of liquid. It is non-explosive in itself, and when mixed with air is used as an explosive power in gasoline and automobile engines. The boiling point of gasoline such as is used for explosive engines, ranges from 150 to 180 deg. F., and the flashing point of the liquid ranges from 10 deg. F., with complete combustion of the vapor. The vapor of gasoline from 1 lb. of the liquid requires 189 cu. ft. of air and as 1 lb. is equal to 26 cu. ft. of vapor, $^{189}/_{26} = 7.3$, so that one part of gasoline vapor with 7.3 parts air may be used to produce a perfect combustion. Fewer parts of air will leave a residum of unconsumed vapor, while an excess of air will lessen the intensity of the explosion, and if the excess is sufficient will prevent the explosion. Gasoline vapor has, when mixed with air, an explosion range from 2 parts air to 1 part of gasoline vapor up to 19 parts air to 1 part gasoline vapor, the intensity of the explosion varying with the mixture. The specific gravity of gasoline vapor is from 1½ to 2½ times that of air. It is colorless and has a penetrating odor.

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* Gas Inspector and Analyst, Department of Public Works, Detroit, Mich., writing in the Engineering News.

SOURCES OF GAS VAPORS IN SEWERS

Our cities are covered with a network of pipes used in the distribution of illuminating gas. Breaks in these gas mains very often lead to the escape of this gas into the sewer systems. Due to the comparative depth of trunk sewers and gas mains, it is not likely that any great amount of illuminating gas gets into the trunk sewers themselves. We may expect and do find it in lateral sewers, telephone and electric-light conduits, where comparatively small amounts would be necessary to furnish an explosive mixture. Where telephone and electric-light conduits have untrapped connections to the main sewers, there will be a tendency for any illuminating gas present in the main sewer to escape into these conduits. Since it is only one-half times as heavy as air, it is more likely that any illuminating gas getting into a main sewer would tend to work its way out through the lateral sewers which feed into it, or through the openings in the manholes in the main sewer itself. The odor of illuminating gas escaping from a sewer would be decidedly noticeable long before sufficient gas to form an explosive mixture became present.

In the summer time, the temperature of the floors of garages and pavements of a city are at or above 50 deg. F., the vaporizing point of gasoline, so that any gasoline spilled on the pavements or on floors of garages, would evaporate and mix with large volumes of air, in which condition it is not explosive, without ever reaching the sewers.

In the winter the reverse is true. The temperature of the pavements and the floors of garages is below 50 deg. F., so that any gasoline spilled is very likely to reach the sewers. The temperature of the water in the sewers varies from 40 to 60 deg. F., so that it is quite likely practically all of the gasoline which reaches the sewer is vaporized there. Since the specific gravity of the gasoline vapors is 1½ to 2½ times that of air, these vapors will follow the surface of the water and will not tend to escape from the trunk sewers through the lateral sewers and the manholes. During the winter, most of the pavements are covered with ice and snow. Any gasoline spilled on the pavements is frozen and becomes mixed with ice and snow so that when we get warm rainy days, the snow melts, thus releasing the gasoline. We may expect to find an unusual amount of gasoline in our sewer system following a heavy winter rain which at the same time forces large quantities of water and fresh air into our sewers. We may then expect to find the composition of our sewer gas to vary and contain unusually large amounts of oxygen which are necessary for the explosion. That is, the average sewer gas when mixed with any gas alone in any proportion could not explode, due to the high percentage of nitrogen and low percentage of oxygen.

We must have oxygen as well as gas or gasoline vapor present in a sewer to form an explosive mixture. To furnish oxygen, we must have fresh air, as air which has stood any length of time in contact with sewage is robbed of its oxygen. So we must expect these explosions to occur after a period of rainy weather. Dry-cleaning establishments use large amounts of gasoline in their cleaning processes, using this gasoline over and over until it becomes so dirty that it cannot be used any longer. The easiest way to get rid of it is to put it in the sewer. Analysis of sewage taken from some of the sewers has shown as high as 1 gal. of gasoline per 1,000 gal. of sewage. This is an extremely high content. If this were general, the amount of gasoline vapors in many sewers would be explosive at all times, if sufficient oxygen were present to allow the explosion.

MEANS of IGNITION

The streets of our cities are covered with a network of underground electric systems, such as telephone, electric light, street railway and power cables. Evidence of leakages in these underground electric systems is always present in the corrosion of water and gas mains by electrolysis. An electric spark due to this leakage would cause an explosion of any gas mixture which was explosive. Sometimes the side of a manhole cover is cut off to make room for a street car. A spark from the street-car wheel as it goes by the manhole may ignite the mixture. A fire engine passing over the manhole may drop a spark which will explode an explosive mixture. The flame from a lantern taken into a sewer by careless workmen may cause an explosion. A lighted match dropped carelessly on a manhole may cause an explosion. In fact, there are countless ways in which an explosive mixture may be ignited.

THE EFFECT OF CURVES IN SEWERS

Curves in the trunk sewers offer a resistance to the free flow of gases through the sewers, causing them to bank up at these points. Changes in cross-sectional area in the sewer have the same effect. At these points we may expect to find explosive mixtures in our sewers if they are present anywhere. If a means of ignition is furnished, the explosion occurs at these points where the explosive mixture is present. The primary explosion forces the gases through the sewers, putting them under pressure, in which condition a gas which under atmospheric pressure is not explosive, may become explosive. The ignition wave follows the pressure wave and as a result there is a continuous series of explosions throughout the sewer, until a point is reached where the gases present are no longer explosive.

HOW TO PREVENT EXPLOSIONS

It is a case of either elimination of the explosive gases or ventilation of the sewers. It is impossible to absolutely prevent leakages from illuminating gas mains getting into the sewers. It is impossible to keep sewers absolutely free from gasoline vapors. It is impossible to always economically eliminate curves in the sewers.

It is then more a question of ventilation. The openings in manhole covers are designed to do this. If they are allowed to become clogged up with dirt and snow, they certainly do not fulfill their mission. Manholes are usually at least one block apart. If there are sharp curves or change of cross-sectional area in a sewer between two manholes, it is most likely that explosive mixtures will be found. Then that curve must be ventilated. This may be done by means of a stack built inside of the curb line with a conduit running to the top of the sewer. If the natural draft is not sufficient to ventilate the sewer at the danger point, then it may be necessary to resort to artificial draft through this stack. If these danger points are not equipped with stacks, removing the manhole covers for a few hours during the rainy days of winter will no doubt provide sufficient ventilation to prevent explosions.

There need be no fear of a serious explosion in a straight-barrelled sewer at any time. There need be no fear of a serious explosion in any sewer during dry weather. Rainy days during the winter are the danger periods and if care is taken to provide sufficient ventilation at the danger points during these periods, the writer believes that sewer explosions may be eliminated.—Engineering News.

The Use of Hydrated Lime in Concrete Mixtures for Pavements

By Robt. S. Edwards

IT is the purpose of this paper to show wherein certain materials, when put together carefully and correctly, serve to make and meet beyond any question of doubt a pavement which has become a recognized standard under practically all conditions of cost, labor and materials. Such a pavement, when properly laid, has demonstrated itself to be permanent under all varying conditions of traffic.

Concrete pavements meet all of the above requirements, but the concrete pavements of the future must be so put together in their making as to leave no room for doubt to even the most skeptical. It is in this putting together of a concrete to be used for a pavement that the manufacturer of hydrated lime is bound to find an ever increasing demand for his standardized hydrate.

The utilization of concrete as a paving material during the last five or six years has developed into an extremely important business, and is destined to become one of the greatest, if not the greatest consumer of Portland cement. Concrete pavements are found in practically all states in the union, while the various counties of several states have practically standardized this pavement. Notable among these is the county of Wayne, which includes the city of Detroit, Mich. Since the inception of concrete road building in Wayne county, about five years ago, more than 70 miles of concrete pavement have been laid, and the county long ago adopted concrete as its standard pavement. As this county has placed more concrete pavements, and of necessity has had more actual experience in handling concrete pavements than any other section of the United States, it is interesting and instructive to know what its specifications call for and how experience has taught its officials to do their work.

1. Great care is taken in preparation of the sub-base. Experience has shown that more cracking in concrete pavements has resulted from improper and careless treatment of the sub-base than from any other one cause for cracking; consequently the sub-base is rolled hard and made as uniform as possible; also density is desired so that water seepage from the concrete into the sub-base may be diminished as much as possible.

2. Careful specifications for the sand, gravel or crushed rock and cement are insisted upon and carried out to the letter. Careful proportioning and mixing of the concrete are also done.

3. Within the last four years a gradual increase in the richness and thickness of the concrete has been specified and the present specifications call for a 1:2:3½ concrete mixture 7 inches thick for one-piece concrete pavement.

4. Care in protecting and covering all concrete after placing and keeping it covered for at least 10 days. This precaution is taken to prevent the loss of moisture by evaporation from the surface of the concrete.

5. The use of steel expansion joints cutting the entire depth of the concrete at each 25-ft. section and the filling in between these sections as formed, by pieces of felt.

Placing and treatment of concrete pavements under the above specifications have produced results which are very satisfactory, and in carefully analyzing these specifications it would seem that every particle of engineering and common sense had been used. In practically every step in the process of laying the concrete it has been the intention to carry on the work so that future cracking may be eliminated, yet in spite of all these precautions more or less cracking has developed and is generally attributed to settlement of the sub-base or the movement of the concrete, due to temperature changes.

From the writer's experience, gained in the testing of materials which go into concrete, as well as from experience acquired in the supervision of important concrete work and examination of so-called "concrete road failures," he does not believe that the fundamental causes for cracking in concrete pavements are temperature changes in the concrete or settlement of the sub-base alone. There are other primary and extremely important reasons why these so-called temperature and settlement cracks develop at a later date, and until we take proper steps and exercise due care to the right time, we cannot greatly reduce this excess cracking.

No specification for laying concrete pavement, to his knowledge, has taken into consideration the chemical peculiarities shown by Portland cement concrete in its preliminary setting and hardening periods. There has been no special provision for retaining to as large a degree as possible the actual mixing water first used in the concrete mixture. By careful treatment of the sub-base and protection of the finished surface of the concrete after pouring, it is the intent of the various specifications with which the writer is conversant, to retain in the concrete as much of this first mixing water as possible. While these precautions are a great help, they are not quite sufficient, as they rely to a great extent on treatment of surfaces to keep the water from leaving the concrete. The prevention of this leakage of water from concrete after the first few hours in which it is poured is an extremely important feature, and in this connection it is well to bear in mind that the reaction between a solid, such as Portland cement, and a liquid, such as water, is a surface reaction, water being able to react on the surface of the cement grain only, and that owing to the slowness of the reaction and the insufficient amount of water being present, only a relatively small amount of the Portland cement is at first decomposed by water. Consequently if we can actually keep within the concrete mass what little excess mixing water we start with, or introduce into the concrete mass in the mixing some substance that contains or will readily hold excess water which the cement may secure later, we shall accomplish what has not been done before.

There is no more important period in placing a concrete road surface than the first 24 hours after pouring the concrete, for it is in this period that minute spots of weakness generally develop, due to the loss of water by leakage and evaporation and use of water by the cement in setting, causing contraction in the first 24 hours. Upon the later permanent hardening of the concrete, we do not secure a slab of so great cohesive uniformity as would be expected on first consideration.

The general conditions under which concrete pavements are placed are severe, as the majority of work is usually done in the dry spring and summer months when temperatures are high, causing excessive evaporation. The concrete is generally poured on an earth or clay sub-base in a thin slab varying between 4 and 7 inches in thickness. This condition alone makes it almost impossible to secure uniformity throughout the concrete mass, so that after hardening the concrete road slab is subject to far greater variations, due to the segregation of the coarse aggregate from the mortar, than is found in other forms of concrete work. This, of necessity, causes unevenness throughout the concrete, and the excessive cracking and unravelling so often seen in poorly laid concrete roads is directly due to this fact.

It is the writer's opinion that the primary cause of cracking in concrete pavements is due to the loss or leakage of varying portion of the mixing water from the concrete by seepage through the sub-base, as well as by evaporation from the surface of the concrete, which leaves the concrete road slab in such a condition that at later times it will alternately absorb and give up water, depending on the season of the year, and that expansion and contraction of concrete and any movement in its volume are due infinitely more to this alternate wet and dry condition than to any temperature change from hot to cold without presence of moisture.

That the cracking which is directly attributed to the change in the condition of the sub-base, either in settlement spots or in drying out in shrinking, is primarily due to this cause, which is greatly helped by unevenness and variability of the concrete mixing.

The Use of Hydrated Lime

Hydrated lime is a product formed by the addition of accurate quantities of water to known weights of freshly burned quicklime, the finished material being a flour-like powder of great fineness and covering capacity, having more than twice the volume of the same weight of cement in its dry state.

The use of hydrated lime as a void filler in concrete mixtures, and for rendering concrete mixtures more watertight, dates back several years. Numerous tests show that a replacement of from 10 to 15 per cent of hydrated lime in rich concrete mixtures does not decrease the compressive strength of the concrete after three to four months' time, and ultimately increases the strength and permanence of the concrete. It apparently makes but little difference as to its action as a void filler, whether the hydrate is manufactured from a dolomitic or high magnesia lime or a high calcium lime—it being necessary only to have a produce which contains no free lime or unslacked particles. The proper hydration or dry slacking of lime reduces it to a finer degree of subdivision than can be accomplished by any mechanical means.

The amount of water required to convert the dry hydrated lime into a plastic paste varies from 50 to 70 per cent of the weight of the lime, while, to obtain a mortar of similar consistency with Portland cement, an addition of 25 to 30 per cent of water is required.

Unlike Portland cement, however, the addition of water to hydrated lime does not create any chemical reactions. There is simply a lime paste formed which holds its excess water for a long time. Upon the addition of small quantities of hydrated lime, amounting to 10 or 15 per cent, to the weight of cement used in concrete mixtures and the ordinary mixing of such mixtures, the hydrate, which has absorbed a large amount of water, corresponding to its weight, is thoroughly disseminated throughout the concrete mass, and, due to its fine plastic conditions, it is forced immediately into places in the concrete which the cement cannot reach.

Concrete, so mixed, on leaving the mixer, flows more readily into place and the coarse aggregate has much less tendency towards segregation in the concrete mass. In other words, the extremely finely divided condition of the moistened hydrated lime paste has increased, to a marked degree, the covering or spreading quality of the cement, and reduced, to a similarly marked degree, the friction between particles of fine and coarse aggregate.

This answers the question "Why does hydrated lime benefit concrete?" The action is purely a mechanical one, and can be compared to the oiling or greasing of a shaft or bearing. The property which hydrated lime has of absorbing and retaining large percentages of water offers a ready solution to the problem of finding a means for keeping and holding moisture in freshly poured concrete pavements until the slower-acting cement-hardening process can utilize it.

It is obvious that small percentages of hydrated lime, when added to concrete mixtures, in road work, will accomplish the following things:

1. Renders the concrete highly plastic and homogeneous, thus producing density and uniformity in the finished concrete. This condition adds much to the life and efficiency of the road because of the uniform resistance to wear and other stresses.

2. Keeps a certain amount of excess moisture in the concrete while setting.

3. Renders the concrete mass more nearly watertight, thereby preventing the alternate wetting and drying out of the finished concrete.

4. In large pieces of work, these properties given

to concrete by hydrated lime would materially reduce the labor in spreading and bringing the concrete to a uniform surface, which is of great importance in paving work.

Analysis of Factory Building Costs

THE accompanying diagram, reproduced from the Cement World, indicates approximately the proportionate distribution of cost factors in the construction of a typical modern reinforced concrete factory building, by the Aberthaw Construction Company, of Boston, Mass. The building is 150 by 50 ft., with brick curtain walls and interior construction of reinforced concrete. The two lower floors were designed for live loads of 250-lb. per square foot, and the upper floors for 150-lb. loads. The diagram is divided into two parts, denoting the proportionate cost of materials and labor, respectively.

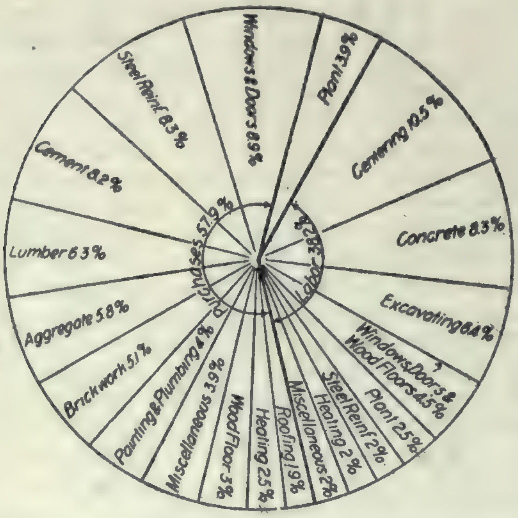


Chart showing proportionate cost of the construction of a typical reinforced concrete factory building.

The popularity of hollow tile is due principally to the fact that the clay which is used is more carefully prepared, harder burned, and used where it will do the most good, comments The Architect and Engineer. Since these walls and webs of well manufactured clay perform all necessary functions in carrying loads and resisting strains, the balance of the wall may as well be void. The voids are cheap. They require no clay. It costs nothing to dry and burn them. The railroad and cartage men transport them for nothing. They do not tire the hod carrier or brick mason. No steel is required to support them in the wall, and they are very good non-conductors of heat, cold and moisture. It is this economy from the clay pit to the finished wall that makes hollow tile popular.

The United States army engineers have long used the following mixture in waterproofing cement: One part cement, two parts sand, three quarters pound of dry powdered alum to each cubic foot of sand. Mix dry and add water in which has been dissolved three-quarters of a pound of soap to each gallon. This is nearly as strong as ordinary cement, and is quite impervious to water besides preventing efflorescence. For a wash, a mixture of one pound of lye and two pounds alum in two gallons of water is often used.

Constructional Miscellanea

Renewal of the holding-down screens in the Cincinnati filters may be eliminated entirely, thus saving a heavy outlay for replacements, if further experiments corroborate those already made to learn whether or not the screens between the gravel and the sand may be omitted. A report on the present condition of the Cincinnati waterworks states that the brass wire screen is gradually going to pieces from corrosion. Extended tests made by J. W. Ellms, superintendent of filtration, with an experimental filter and with two of the large filters thus far are quite promising and indicate a heavier and deeper gravel layer will take the place of the screens.

Plans and specifications were approved recently by the Board of Public Commissions for a three-million-dollar pressure tunnel through rock on zero gradient in connection with the St. Louis sewer system. The scheme involves fou[illegible]rge drop shifts at the upper end by which three thousand cubic feet per second in storm flows is diverted from the existing sewers and introduced into the tunnel. The average drop will be forty-five feet, and the length of the relief sewer is to be twenty thousand feet, of which two thousand feet will be reinforced concrete sewer in open cut, and eighteen thousand feet of 16½ x 16½ feet neat concrete lined tunnel, nearly all limestone.

A difference in water density at the lower ends of the Miraflores and Gatun locks at Panama has developed a current of probably three or four miles an hour under certain conditions. At the stage of a downward lockage, when the surface of water in the lower chamber has been brought down to evenness with that in the approach, the water within the chamber is more than half fresh. In consequence it has less density than the sea water beyond the lower gates, and when the gates are opened the heavier water thrusts its way inward against the lighter, causing a current opposed to the outward passage of a vessel. The current being temporary causes no serious inconveniences, and is being studied principally to determine accurately the conditions for the manipulation of the towing locomotives.

Bending reinforced rods is accomplished very simply and satisfactorily at Balboa by an arrangement somewhat similar to the rail-bending machine. The rods are bent by the thrust of the piston rod of an engine cylinder while the rods are held in place on a table in front of the cylinder. The table is a steel plate bored with numerous holes, wherein are placed movable steel pegs for limiting the bending. Two such equipments are in use; one includes a single 10-in. cylinder recovered from an old French locomotive. This outfit places a single crimp in three or four ¾-in. rods simultaneously. The second equipment employs two 14-in. cylinders taken from the dumping mechanism of a 2 cu. yd. concrete mixer, which are mounted on opposite sides of the table and make opposite bends in rods as large as 1¼-in. in diameter. In both cases, compressed air is used at a pressure of about 80 lb. per sq. in. It is claimed that five men in one hour can bend as many rods as they formerly did in eight hours.

An artificial island of reinforced concrete has been built in the Mediterranean at Hyeres Strait, near Toulon, the great French naval base, which is to be used solely for testing torpedoes. The island is not a large one, being less than 80 feet long by about 50 feet broad, and is built upon a reinforced concrete caisson which was towed out from Toulon and submerged. It is divided into compartments by walls 4 feet thick, in the largest of which, 10 feet below the sea level, the torpedoes are handled. Projecting from this compartment are three torpedo tubes, while above the surface of the water, 10 feet in the air, are two aerial-torpedo tubes. The operating mechanism, which uses electricity as a motive power, is all contained in the superstructure built over the caisson, and lighting and ventilating systems, as well as wireless and searchlights are provided. An electric crane extending out from one side permits the torpedoes to be lifted from the water and returned to their stations after practice.

Ventilation—Artificial or Natural

By Paul W. Goldsbury, M.D., Warwick, Mass.

To secure a texture of air indoors that more nearly resembles that outdoors is the ambition of sanitary engineers who have anything to do with buildings or their construction. To live indoors and still enjoy some of the purity of the air that is to be found in the open is a matter of vital concern to the average worker, for the greater part of his day is passed under roofs and inside walls. Civilized man has been dwelling in his house for ages, adding comfort to comfort with apparently little regard as to what such confinement cost him in health and vigour. His eyes, however, have been suddenly opened, and that within a bare generation, for he has seen and known of the response which the "white plague" sufferer has made living under clear skies. He is learning something of the connection between the shut-in-ness of his office, shop, and sleeping apartment and his occasional ills and ailments. He is being persuaded that where the real sick are doing so well there must be something worth while for him in the air tinted and coloured by the sun and toned and perfumed by lake and stream, forest and field.

The human race has always needed shelter; a roof is wanted in all climates, either to protect from the rain and snow, or to shield from the light and heat of the sun. The play of the elements and the changes of temperature require walls also set so close as to shut away winds and cold. The house has been divided into compartments. Rooms afford individual privacy or establish limits necessary for business or housekeeping interests. In a thousand and one ways has the home and the school, stores, factories, and all sorts of buildings been made snug, comfortable, or divided up so as to anticipate every little thing which has to do with usefulness and service. The occupants have been protected from the struggles of the elements out of doors, and the changes of the seasons, and the structures have been more and more adapted and furnished and made to serve the man in his work, his studies, his whims, his pleasures. But the finished, the complex building is seen more and more to complicate and obstruct the free circulation of air. Man is so occupied with his art, his craft, his own creation, that he has forgotten the physical breath of life. The genius of the scientist and physician, the skill of the engineer and builder, all added to the concern and diligence of the janitor, have not met satisfactorily the problem of fresh air. The patient sufferer of tuberculosis, though compelled to be still, has been forced to listen to the stiller voices of Nature, and learned lessons from her heart and ways which must become known everywhere.

All sorts of ventilating systems have been used and devised to introduce, purify, moisten, and change the air. To continually bring the large quantity of air necessary in factories, schoolhouses, and large public buildings, to wash out the dust, to heat, and at the same time keep up the humidity, entails an expense which seems prohibitive in the case of smaller buildings and dwellinghouses. The demands for sufficient moisture where cloth fabrics are woven have long been realized and have been met by the introduction of elaborate apparatus for humidifying the air. The popular recognition of the demands of the human fabric for moisture comes long after. To heat, to moisten, to remove the dust, and to supply the quantity of oxygen considered necessary for each individual, is only tackling a part of the problem in giving him the kind of air he needs. Students who were endeavoring to serve the public in providing better ventilation have met with success in a measure. Things might have been worse. They have had to fight organized greed and that race for wealth and competition which produces crowding and congestion, a tide very difficult to stem. These students, in the practical application of the results obtained in the laboratories, have been preparing the way and educating the public in ventilation. But it remains for those compelled to live in the open to carry forward such labours. Man's workshop is always more or less restricted, but the laboratory of Nature has practically no bounds.

How many people can be herded and boxed up together and not impair both their own health and the efficiency? The summer camp furnishes a marked contrast to the stuffy office and the winter apartment as to the tonic qualities of the free and fragrant air. Many of the newer banking and trust company offices show an evidence of a concession to that elemental fact that breathing space is necessary. The height of their ceilings seems to indicate something of a protest against the low-ceiled rooms of the day. It must be also a matter of good business policy to afford the high officials of such and other large institutions elbow room on all sides where they have important affairs to transact. Precision in work and clarity in mind and thought must be nourished by a generous amount of atmosphere. There are virtues in the high-vaulted cathedrals in the space afforded the heated and fouled air to rise and escape.

Two hospitals about the city of Boston have found quite a helpful suggestion from a very primitive source of architecture which they have adapted to their own needs. The Indian tepee emphasized some very ordinary lessons in physics. The Indian is said to live in his own chimney; at any rate, he has more or less fresh air coming in the doorway or under his walls, and much of the bad air must, of course, follow the natural drift, rise and escape with the smoke of his fire at the apex. Windows are seldom kept open at the very top of a room, and even if they were the ordinary ceiling is horizontal, so that there are pockets or large spaces where the air is not changed. If the ceiling or roof slopes, then the air as heated tends to flow upward all the time from the rooms to drift into that uppermost space (in this case about 8 ft. across), under the ridge running the length of the building between the gables at the ends of the roof. In fact, that part of the roof is raised so as to allow windows to be put in on the other side. One is immediately struck in going through these buildings, particularly if any windows are opened below and above, at the freshness of the air. The currents from the ordinary levels to those under the apex of the roof seem to establish such a circulation that even the harmful odours and gases are wafted upward and entirely out of the building. When the air is still outside, that from within will come out of the windows opened on both sides of the roof. But with a wind, those on the leeward side, away from the direction from which the wind comes, only are opened. In that way, instead of the air being driven back in at the roof, it is sucked out. The genius of the white man has gone the Indian one better on that point. Of course, in such an arrangement the quantity of air passing in and out requires an extra amount of heat, but there are compensations. The response of the patients treated in these sanatoria seems to warrant the added cost of fuel.

In a broad study of all these considerations of purity of air and ventilation, one reaches the conclusion sooner or later that health is a matter of space, of variations in the character of the air, and that unobstructed nature is a master teacher in these arts. Consider how the movements of the sun, the rotation of the earth, produces the changes in temperature, and add to these the outlines and area of land and water, hills and valleys, all the geographical and topographical considerations which affect the direction of air-currents, their moistness and dryness. The earth in its geological out-croppings and chemical strata affect the air "electrically," one might say. The life of the woods, the fields, the sea, add to the character and aroma of the air. By all these forces playing in and out freely, Nature can present all sorts of faces and moods; she revitalises the atmosphere by gentle or more abrupt gradations. Can artifice approximate all these physical variations?

The hospital structure above described, with ample grounds about it, should be thought of as at a stage about midway between the regions where the elements are free and untrammelled and the pretentious office building in the heart of a large city. In the latter no expense may be spared to introduce air from a strata or level beyond the range of the ordinary pollutions of the atmosphere. Such air may be further washed and cleansed, moistened and heated, but imagine it in the long and circuitous channels and conduits through which it is introduced into the building as robbed of many of the virtues which it may have possessed. The walls of this long route must more or less taint it or cause it to lose its varying character. It must seem to the occupants to have pretty much the same smell all the time. Is it actually or only scientifically pure? Scientific men are already coming to recognize that some of the standards formerly set up as necessary for a safe atmospheric condition are not so absolutely essential. Air may even have a high carbon dioxide content and not be so injurious, providing it is not in so stagnant a condition, but is subject to waves and currents and shows variations which react upon the skin and sensory nerve fibres, giving evidences of tonic and harmonic changes. Air must be conceived of as offering continuously impressions to the nose and skin, which gauge its value.

The problem of ventilation is rendered more and more complex where there is crowding, where the natural is replaced by the artificial. The trend of city development, the skyscraper, makes fresh air costly. Health is very costly, but life, after all, can not be valued. Is there not, then, an impassable wall in city life? Must not the city sooner or later disintegrate in favor of the country? Health must in the end be the measure of real efficiency. The artificial must bow sooner or later to the natural forces. The laboratory student, with all his earnestness, zeal, and ambition in this behalf, has not as much at stake as the poor invalid who has to take to the woods for his life. The sensibilities of the latter are keyed up to protect his waning vitality, and may register discoveries beyond the delicate instruments of the former. Nature in all its nakedness and wildness must more and more be courted when and where it can best develop those sensibilities.

In all this, Nature but compels man to return to her own side for instruction and life. Man has placed his laboratory too near the market place, too near congested centers, and, though he must study these conditions at close range, his scientific vision becomes blurred—the atmosphere, the fumes, the fret of the environment hammer are too much upon his perceptions, and so warp his conceptions, his results. He must know the life and various complications by experience. His conclusions, taken from one side, are sure to include error. His viewpoint must be ventilated, clarified by some of the lessons which those compelled happy for the life and all it affords and are desirous of sharing the good things.

A New Toronto Warehouse

Construction work is almost completed on the new warehouse which is being erected for Mr. George Greisman, on the northeast corner of Richmond and Duncan streets, Toronto. The building is mill construction and consists of five storeys and basement. The exterior of the structure is of red plastic brick. It occupies a frontage on Richmond street of 101 feet and on Duncan of 99 feet 6 ins. In the construction provision has been made for the renting of the building in separate floors and each floor is so constructed that it can be occupied, if required, in whole or in part. Stairways and elevators are provided in the centre of the building, thus affording communication with either end. The heating installation is the Spencer self-feed system throughout and the building will be equipped with elevators, both passenger and freight, of the Otis-Fensom type.

The general contractors are the Standard Structural Company, Limited, Toronto. The contract for the brick work was carried out by Mr. J. A. Williams, Toronto. Sand-lime brick for the interior of the building was supplied by the Harbor Brick Company. The Don Valley Brick Works supplied the ornamental brick and the Milton Pressed Brick Company, Limited, had the contract for the buff pressed brick. The carpentry work is being carried out by the general contractors; the heating and plumbing by John Ritchie Plumbing & Heating Company, Limited; the electric wiring by Rice, Green & Company, Limited; and Keith's Limited are installing the sprinkler apparatus. The roofing, which is ordinary tile and gravel, was constructed by J. Van Sickler & Company, Limited. The contract for the painting and glazing is being carried out by Mr. E. Hoffman; the window glass was supplied by the Toronto Plate Glass Company, Limited; the window frames by H. M. Lickley, Limited; steel and metal sashes were supplied by the A. B. Ormsby Company, Limited; the concrete sills were manufactured and supplied by Cement Products, Limited; beams and columns by the Boake Manufacturing Company, Limited; and sand, etc., by the York Sand & Gravel Company.

The building, which will be ready for occupation about the end of August, will cost about $75,000. The architects are Messrs. Chadwick & Beckett, Toronto.

The Foundation Problem in Building Construction

THE foundation of a building is the first part of its construction, and by far the most important to be made exactly right. Big engineering propositions of foundations for skyscrapers and extremely large buildings are always taken care of by capable engineering research and application, and have been discussed at length by the technical press from time to time. What we are calling attention to now is the foundation problem of the cottages, the more pretentious residences, or other smaller buildings, of which there are immense numbers, and which constitute the larger part of all construction as well as the main consumption of all building materials.

Let us look at the foundation problem fairly and squarely. It is customary, when a man intends to build a bungalow, to look for the very cheapest material possible for all that part of the building which is underground, because it does not show. As such foundations have a very insignificant load, almost anything is sufficiently strong to carry it.

Fifteen years ago twenty-four-inch rubble stone walls, laid in lime mortar and having a footing of double sized rubble stone, was the standard foundation for such buildings. Such basements were invariably damp, and it made very little difference whether the frost got under the footing or not, because there was enough "give and take" in the irregularity of the bearings of the rubble and the soft mortar, to take up any ordinary frost heave, or to conceal the cracks that were the results of minor settlements in the foundation walls, where the footing happened to rest on soft spots of earth or on shifty sand.

At the present time the most popular foundation for such a building has come to be the 12-inch concrete wall, which, when properly made, is just about as nearly a perfect proposition for the purpose as can be devised; but not one out of a thousand is properly made. The contractor who takes the job generally figures from the plans of an architect who has never seen the lot and who assumes that the grade line will represent a level surface of the ground. He shows excavations amounting to a depth of 4 feet, so as to give a 6-inch margin. The ground slopes to one corner of the building in nearly every case, so the excavation on the low side will be no more than 6 inches or 10 inches. In fact, it may not extend through the black loam of the surface, and at that corner the building is entirely unprotected from the attacks of frost.

The contractor cannot afford to furnish any more material than he has figured to use in the foundation, for more than likely he has taken the job so as to simply make his own wages by putting in the foundation. Should he deepen the trench on the low side, and add three additional yards of concrete to his foundation, it would amount to his wiping out all the profit as well as his wages for putting in the foundation. The result is that the foundation as put in may be short of cement, but even when there is plenty of cement put into the concrete, the work is done so cheaply that the contractor cannot afford to mix the concrete properly. It is usually just a case of shoveling in some crushed rock, along with a little sand and a little cement to make a spongy, porous concrete which is not worthy of the name and not fit for any structural use.

Naturally, such a foundation has to be daubed up with plaster on the outside, then it has to be treated with all manner of waterproofing compounds and devices to keep the soil waters from penetrating the wall and so making a wet basement. In spite of all the precautions of waterproofing, close to one hundred per cent. of all such foundations are damp, are wet, and will always be unsatisfactory.

Notwithstanding all that has been published and said by technical men on the subject of mixing concrete and making it wet enough so as to puddle the moisture to the surface, very little puddling of concrete is ever really done. The main dependence for securing solidity by the usual foundation contractor is the weight of the material when it is shoveled into the forms. True, the workmen may walk backward and forward, stepping on the material, and so tamping it down with their weight, but it is incomplete, insufficient and unsatisfactory. If this is not remedied it is quite certain that there will be a return to the use of rubble stone for foundation purposes, which will keep the concrete man out of a very large portion of the business which he now enjoys.

Let us assume that all the materials to make good concrete are assembled on the job, still it takes some additional assembling to that of the materials. It requires sufficient water, and water is not always the easiest thing to obtain on a little foundation job. When the weather is very hot, and the water has to be hauled in barrels or in a tank wagon, there is a very pronounced tendency to skimp on the water, just as there is to skimp on the cement and in every material that is in the work. There is no substitute for water or for adequate mixing in a concrete job.

Half of the contractors who put in residence foundations proceed by the following method: They will spread out on a mixing board, or on the ground a yard of crushed rock. On top of this they will spread half a yard of sand; on top of the sand they will spread, fairly evenly, four or five bags of cement. Then they will throw on a few buckets of water and immediately begin to shovel the entire mass into the forms, without any pretense of turning it over or mixing it, claiming that the stuff is all loose and wet and mixes as it goes in. They claim that it is impossible to keep it from mixing, and consequently, there is no use to go to the expense of paying men to shovel several tons of material two or three times, when it can be done with one shoveling.

This mixing proposition is very seldom improved upon, even when there is a small hand mixer on the job, because it is somewhat of a back-breaking undertaking to grind the crank of a hand mixer, and the laborer who has this part of the work to do does not care a rap about the quality of the material he is producing, and every turn that he can avoid is carefully avoided.

There is no question whatever but that a good solid foundation made of concrete, well mixed, well tamped and properly proportioned, will be just about as tight as a jug. If it extends down to 3 feet 6 inches below natural grade it will be just about as safe from frost and in every way as nearly perfect a foundation as can be secured.

When the excavation for a foundation extends 3 feet 6 inches, or even 4 feet below natural grade, it will not be impervious from an attack by frost, unless the back-filling of dirt against the foundation, when finished, is well rammed into place and the dirt piled up a little higher immediately so as to throw the surface water a few inches away from the building.

It would be difficult to estimate the amount of money involved in the damages to buildings where lack of depth of the footing allows the frost to go under the building.

There is an idea prevalent among even experienced contractors that loose dirt from the excavation can be piled up against the foundation of the building and so built up to make the 4-foot depth to their footing. Made ground is not a protection against frost until it has had from thirty to thirty-two winters, even though the footings are placed as deep as sixteen feet in made ground.

The writer recently observed the foundation of a building resting on made ground which extends ten feet below the grade of a modern street. The total filling, however, amounts to about twenty feet. Last winter the frost penetrated into the made ground and got beneath the footings, which were ten feet below the present grade, and raised all four corners of that building so that extensive repairs were necessary during the present summer. In fact, made ground never becomes as solidly stratified for the resistance of moisture as the stratification of the natural surface of the earth, and this is why we always use the expression of "natural grade."

Made ground should never be considered as having any value in the placing of the footing of a building. A 3-foot 6-inch or 4-foot excavation below the surface of the natural grade does not indicate that the penetration of frosts in severe winters is limited to that depth. Penetrations of frost into the ground have been found seven and even eight feet. But it does mean that in the usual construction of buildings the quantity of moisture that penetrates through the various earthly strata to the depth of three and one-half feet is not sufficient to form a crystalline arch of ice which by contraction and expansion disturbs the footing of the building.

The surface drainage of the building at completion naturally becomes an important matter, for if rain water is kept away from the wall it will not go under the foundation. The owner should always be cautioned with regard to his responsibility in keeping the walls, especially those of a new building, from standing in water while the fall rains are soaking into the whole surface of the ground, because when the frost period comes this water in the soil will be the vehicle upon which the frost travels to go underneath the footings and destroy the superstructure.

There is no unknown factor to the problem about the construction of a perfect foundation for the buildings of the class mentioned, but there is a very great difficulty in securing the construction of such a foundation which is positively good. The services of a capable architect are very often cheap where they result in the securing of a good foundation. No architect has performed his duty to his client unless he has provided a foundation which will go down deep enough below natural grade to protect it from the frost danger and dense enough to protect it properly from the seepage of lateral pressures of water.

There is no necessity for a wet or damp foundation, nor is there any occasion for a foundation that heaves with the frost; because it is simple enough to have it extend at least three feet six inches below natural grade, at all parts of the building, and to have the dirt filled in and thoroughly tamped. Then have the outside of the building drained carefully for a year or two, or until the dirt immediately against the foundation has had a chance to assume something very near its former consistency when in its natural state, before the excavation occurred.

The practical foundation men who read these lines will find something which, if applied, is well worth the space devoted to this article.—Rock Products.

The cost of unloading gondola cars was materially decreased at the Aberdeen, S.D., sewage disposal works according to W. G. Potter in a paper on the plant presented recently before the Western Society of Engineers, by rigging up a block and tackle so that a drag scraper could be pulled lengthwise of the car, dumping at the end over a trap into a Koppel industrial car beneath. The material was 175 car loads of broken stone for the sprinkling filters. By hand the work cost 45 to 65 cents per yard, a figure cut to from 19 to 24 cents per yard. A switch track enabled cars to be placed adjacent to the filters. The total average cost was 32.4 cents per yard. Laborers were paid 25 cents per hour.

All bent bars shown on reinforced concrete drawings should be given some reference mark, which should consist of capital letters and numerals, or numerals only. The following scheme is suggested: For the first ⅜-in. bent bar mark it 300, the second 301, and so on; mark the first ½-in. bent bar 400, and so on. For ⅝-in. bent bars use 500. ¾-in. use 600, and so on. The hundredth figure will indicate at once whether the bar is a ⅜-in. bar or a ⅞-in. bar; thus 703 would indicate that ⅞-in. bars are to be bent and probably it is the fourth in the series of ⅞-in. bars having different bends.

Any attempt to economize in the cost of reinforced concrete by cutting down the proper weight of steel is excessively foolish. In a case recently reported, the attempt to save $1,000 on the steel in a $45,000 contract reduced the factor of safety by 25 per cent.

Safeguarding Buildings Against Fire

Essential Features of Construction Designed to Prevent Spread of Flames—Importance of Sprinklers and Waterproofed Floors

By Alfred Ludwig

If a building be so constructed that the confinement or stoppage of a fire at the point of its origin can be accomplished, the problem preventing heavy fire losses is practically solved. To achieve this object it is essential:

First.—That every avenue by which fire can spread from storey to storey, or building to building, be protected or cut off.

Second.—That floor areas open to the spread of fires be made as small as possible.

Third.—That combustible material entering into the construction of buildings be made a minimum.

First.—Fires, in order to make headway, must have fuel and oxygen, and without the latter must soon die out. If there be unprotected openings in buildings, in the floors and walls, a draft will be created quickly, the hot air rising and the cold air rushing in providing the necessary oxygen for the combustion of the fuel. It is therefore evident that in order to confine a fire to the point or place of its origin, no opening, however small, in either the walls or floors should be neglected, for, as long as it provides an avenue for the hot air to escape, a draft will be created and the fire will spread. A building with unprotected floor openings partakes very largely of the nature of a stove, the flues being provided by the elevators and stairway wells, the stock and contents being the fuel.

Many of the buildings, even though of comparatively recent construction, are designed apparently as if the intent were to provide as many means as possible for the spread of fire, little or no provision having been made to protect properly the stairway, elevator or window openings. At the present time, however, the hazard of unprotected floor opening is appreciated fully by the students of fire protection, and great advance has been made in providing adequate protection in this direction. Most of the building codes of recent enactment have covered this important subject fairly well. The same, however, cannot be said in regard to the hazard of the unprotected window and other openings in walls of buildings, which is equal to, if not of greater importance than, that of the floor openings.

The treatment of this hazard in most of the codes and laws has been very unsatisfactory. It is true that some provision has been made for the protection of window openings thirty feet or less, but no provision has been made for protecting the upper storeys in buildings from the spread of fire through the windows from fires originating in the lower storeys. Experience has taught that unprotected window openings are one of the most prolific sources by means of which fires can spread, and it seems strange that so little consideration has been given to this subject. Possibly the reason may be attributed to the prejudice of the public against the use of wireglass as obstructing light, and in part to cost, and this has had its effect on our lawmakers. The first reason is in the main without weight. The amount of light obstructed is practically negligible in the case of clear, plate wireglass. After being accustomed to the wiring one ceases to find it objectionable. The cost is more serious, but it would seem that the public welfare should receive the first consideration.

Exposures facing streets adjacent to buildings are hazardous in the extreme, yet no provision of the present-day law recognizes this important fact. Fires occurring in buildings will break through the front quickly (and this is especially true if the wind is in the right direction), and be communicated to the adjacent premises, unless the wondows be protected.

As buildings become of greater and greater height the problem of window protection becomes more and more important and necessary. The stories of a very large percentage of fires demonstrated the ease with which fires are transmitted and spread through unprotected window openings. The secret of adequate fire protection consists in making each storey of a building a fire section, cutting off every means by which fire can be communicated to it from the other storeys.

In order to obtain the maximum security in buildings, the window and floor openings should be a minimum, for the greater the number of these be, the greater the number of avenues provided through which fires can spread, and the greater the number of vulnerable points that must be protected. Even with the best of protection, window and floor openings are always weak spots in the protective armor of buildings. Doors in the enclosures at stairways and elevators may be left open, or they may fail to close, or the enclosure itself may yield to the attack of the flames, or the window protection fail and permit the flames to spread to other storeys.

The statement that the number of stairways should be a minimum may not be in accord with the ideas of many, who at this time are advocating more and more stairways in buildings to facilitate the exit of the inmates from buildings in time of fire or panic. This purpose can be accomplished to far better advantage, and with greater safety to the inmates, by a freer use of fire walls and less stairways. By means of fire walls the various storeys of a building can be divided into fire sections, and through protected doorways the inmates can escape from the danger zone to safety in the adjoining section.

In connection with the problem of protecting life in buildings, it may not be inappropriate to call attention to one most important phase of this question, and that is panic. Many persons who are advocating an increase of the number of stairways in buildings have rushed to the conclusion that the large loss of life in buildings in recent fires is due mainly to lack of exit facilities, and they seem to be of the opinion that few, it any, lives would have been lost if adequate exit facilities had been provided. A careful study of the facts in each case where large loss of life has occurred, apparently by reason of fire; seems to point to a panic among the inmates as the real reason, and not so much to lack of exit facilities.

When a panic occurs reason is lost, and all rush to escape at once, generally resulting in blocking the exits, the strong beating down the weak. Again, under these conditions, it is extremely difficult to distribute the inmates so that each exit will take care of its proportionate share.

Since panic is produced by a state of mind, no safeguard that can be provided in buildings can be effective against it and prevent loss of life. It is therefore almost useless to multiply the stairways and open up new ways by which fire can spread. Fire drills and education only can be effective.

As previously pointed out, stairways, even when protected, are liable to be sources of danger. They should, therefore, be placed as far as possible in fire towers, access to the several storeys being by means of exterior balconies. Communication between the several floors is thus practically cut off.

In protecting stairway and elevator openings the enclosing walls should be constructed of brick, terra cotta, concrete (cinder or stone) or other approved fire resisting material not less than eight inches in thickness, with self-closing, solid Underwriter fire doors, hung with strap hinges at openings. Wireglass panels should not be permitted in these doors. Since light, air and ventilation are necessary in most buildings, window protection can best be secured by means of automatic standard Underwriter fire windows, glazed with wire-glass. While standard fire shutters, if closed, may give better protection against fire, yet the impossibility of keeping them closed during work hours, and the difficulty in closing in time of danger, due to excitement, militates largely against their use as a means of efficient protection except in ware or storage houses and other buildings where light is not essential. On the other hand, wireglass windows are always ready for service, and if provided with a fusible link will close automatically in case of fire.

Second.—In order that fire losses may be as small as possible it is important and essential that areas included in any fire zone be limited. Large, unrestricted floor areas, containing in many cases values running well into the hundreds of thousands of dollars, are only too common in nearly all the great cities of the country, and they furnish a condition pregnant with the possibilities of heavy fire losses. A fire occurring will spread quickly over the entire area, destroying thousands of dollars' worth of stock; in addition the damage by water is greatly increased.

By means of fire walls the fire zones can be restricted greatly, and fire losses curtailed. In addition these walls serve another purpose in providing a means to protect life by furnishing additional exits in time of stress. It is just as essential to provide fire walls in fireproof as in non-fireproof buildings, since the stock can become fuel for a fire just as readily in one case as in the other. Both classes of buildings should be treated alike in this respect.

While there are provisions in our laws to restrict floor areas in non-fireproof buildings, practically no limitation is placed when buildings are of fireproof construction, the idea being apparently that, since the building itself is incombustible, its contents must be equally so.

The whole subject of fire walls in buildings has never received the consideration that its great importance merits, and it is to be hoped that future laws will remedy the failure of the past.

While fire areas should be as small as possible, it is recognized that the exigencies of modern business must be taken into consideration and a compromise made with the opinion of the fire expert. It would seem that a limitation to 5,000 square feet of floor area in unsprinkled, and an increase to 7,500 square feet in sprinkled, risks is not asking too much of the property owner.

Third.—The next essential requirement in the defense against fire is that the use of combustible or inflammable material in the construction of buildings be restricted as far as possible. This is especially necessary in connection with the exterior of buildings, which should be of such a character that no fuel be provided upon which a fire can feed. Combustible store fronts, bay and show windows, signs, roof structures, and also, as far as possible, window frames and sash, doors, etc., should be eliminated.

The large amount of combustible material that has been permitted in the past to enter into the construction of the exterior of buildings, or to be placed on the roof, or to be attached to the sides, has provided a means for the rapid spread of fire from building to building, and in consequence increased the possibilities of a conflagration. This latter danger would be almost negligible if the exterior of buildings were of fire-resisting materials and all exterior wall openings protected.

SPRINKLERS

In the foregoing discussion an attempt has been made to point out the essential features that should enter into the construction of a building in order to confine a fire to the place of its origin. If, in addition, a standard equipment of automatic sprinklers be provided, it would appear that the last word has been said in protecting buildings agains the ravages of fire. No means as yet devised equals in effectiveness the automatic sprinkler in confining or stopping a fire at its source. The sprinkler is always on guard, and its work done before a fire ordinarily can gain any headway.

Economic reasons will militate largely against the universal use of the automatic sprinkler, and it is hardly to be expected that in buildings of a private or semi-private nature compulsory installation of the sprinkler can be enforced; yet, on the other hand, there are many buildings of a public character, such as factories, workshops, lofts, warehouses, places of assembly, etc., where large quantities of combustible materials are used or stored, or where large numbers of people work or congregate, in which the installation of the sprinkler could be required by law.

WATERPROOFING FLOORS

There is one other subject that may be touched upon in discussing ways and means to prevent fire losses in buildings, and that is the waterproofing of the floors of buildings. It is a well-known fact that a very large percentage of the annual loss attributed to fire is due to water used in fighting fires. In many instances the loss due to water damage may be greatly in excess of that due to fire. Water thrown on fires in the upper storeys of buildings finds its way through the ordinarily pervious floors to the lower storeys, damaging stock, plastering, decorations, etc. If more attention were paid to waterproofing floors and providing proper drainage, a very large reduction in the annual fire losses would result.

CONCLUSION

It would appear that in the battle against fire three lines of defence are indicated:

First.—Fire should be prevented, as far as possible, by means of the effective enforcement of fire prevention laws.

Second.—Fires that occur in spite of fire prevention laws should be confined or stopped at the point of origin. This can be accomplished most efficiently by means of the installation of a standard equipment of automatic sprinklers.

Third.—If the sprinkler line of defence fails to confine or stop the fire, it should be confined to the storey or building or its origin. This can be accomplished by protecting all windows and floor openings, and by curtailing the use of material of a combustible nature in the construction of buildings, and especially on the outside thereof. If buildings are protected as outlined the danger of a conflagration is practically eliminated.

Curious Building Laws of Ancient Times

H. B. McMaster Brings to Light Some Surprising Historical Facts

It has been estimated by the underwriters that 27 per cent of the fire loss in this country comes from fires that extend beyond the buildings in which they originate, so stated Mr. H. B. McMaster, Commissioner of the Associated Metal Lath Manufacturers in a recent paper before the Up-to-Date Club of Youngstown, Ohio.

A reasonable conclusion is that these losses are due to the inflammable construction of our buildings.

To correct this a proper building code should be adopted in every state and municipality.

Mr. V. D. Allen, City Inspector of Buildings at Cleveland, was good enough to place at my disposal, Mr. McMaster continued, the result of his research into the history and evolution of building laws. Among other things he found that from the Jews came this effort at Code building:

"One who builds a new house must erect a battlement around the roof so that no person shall fall from it. The battlement must be at least ten fist-breadths in height, and must be well constructed so that one may lean upon it without apprehension. To guard against injury, one must not leave a well or a pit on one's premises uncovered, nor must one keep a vicious dog, or a broken ladder. It is forbidden to walk alone at night, to stand under a wall that is like to fall, to walk upon a poorly constructed bridge, to enter a ruin, or to drink in the dark from a well lest some poisonous animal lurk in the water."

It is within the range of reason to expect that a building inspector with small fists must have been popular with builders in Jerusalem.

"Sky-Scrapers" Popular B. C.

In the days of Solomon, there were buildings ten storeys high. One rabbi tells of climbing 100 feet to his room. Herodotus tells us there were houses in Babylon four storeys high and Greek historians report many houses in ancient Tyre ten storeys high. Athens had a building law limiting the height of buildings for residences to ten storeys.

About the year 325 A.D., when Constantine, the Roman emperor, determined to establish his capital on the Golden Horn, he built a wall across the peninsula as the limits of his city and the dividing line between city and country taxes.

Speculators from all parts of the empire rushed in and bought up land, raising real estate prices over 300 per cent within a year.

High buildings were the logical outcome of this condition and the capitalists sent to Rome for architects who could design higher buildings, with the result that in ten years the new capital rivalled Rome in this regard.

Constantine, finding the view of the city and bay obstructed by these higher structures before he could complete his palace, issued an edict forbidding buildings more than 100 feet high.

A wail went up from the speculators but the tops of the buildings had to come off and it is recorded that one block lost the four upper storeys which would indicate that there were buildings from 125 feet to 135 feet.

Evaded the Laws Then as Now

It is related that one Apothagos built a row of houses between the royal palace and the sea. They were of stone and brick as required by law and within the limits of 100 feet, but on top of this he built frame structures of three storeys. The royal "inspector of buildings" ordered these frame superstructures removed, but Apothagos, claiming it was only a temporary structure for housing his workmen while they completed the building, went into court with it. After ten years of litigation, the superstructures were torn down, but all this time royalty was much offended by the unsightly buildings which stood between it and the sea.

It is interesting to learn that every tenant in a Roman tenement had to look to his own security. Therefore, at dark all doors were barred, windows secured, and in the better class buildings a watchman was hired from a common fund. Sometimes two such watchman were provided, one of whom was chained fast at the front door.

The Incendiary Nero in a New Light

The average person having the belief that Nero was an imperial incendiary will be apt to suffer a shock when he learns that a most comprehensive and practical fire prevention building code was formulated and enforced by this ruler whose name is heard more often in obloquy than in praise.

Some historians say Nero's act of burning Rome in the year 64 A.D. was not without design; that it was, in fact, an efficient way of removing buildings to make way for a great city plan. However this may be, it is a fact that a better order of things resulted. Ruins were hardly cold before the working population of the city were set to work clearing away the debris, and the royal architects, without regard to former ownership, laid out avenues, squares and parks on a grand scale. A law was enacted that no residences should be higher than twice the width of the adjacent street. This seems to be the earliest record of provision for limiting the height of buildings with relation to the width of the street on which they faced. Tenement houses were required to be isolated, and the two or three lower storeys had ceilings resting on stone or brick arches, wood construction being permitted in upper storeys only.

We learn that in front of every home the owner was required to erect a wooden portico to protect the passers-by from the rain and sun.

It was a magnificent city that Nero began, but after his death in the year 68 A.D. his ambitious plans were ignored or forgotten; the public squares were sold to speculators and high tenements along narrow streets again became the order.

In later times we learn that Venice limited the height of buildings to 70 feet, Florence to 180 feet, Paris to 60 feet, and Toledo to 75 feet.

Rheims had a curious law forbidding any structure to be higher than the eaves of the Cathedral, and it was the duty of the sexton to look daily from the port holes of this Cathedral when a building was being constructed to see that it did not rise higher than the level of his eyes.

Practically all ancient and mediaeval building laws dealt with residential structures, since the problems of office and industrial buildings were reserved for this age to deal with.

The removal of septic tank scum after it has become ripe was advocated in discussion by W. D. Gerber at a recent meeting of the Western Society of Engineers. If the scum is not removed it turns into a leathery gelatinous substance and finaliy much of the material drops to the bottom and is difficult to remove.

A report issued by the Austrian Society of Engineers and Architects gives the results of an investigation conducted by the Committee on Reinforced Concrete appointed by the Society. Facts, rather than theories, were kept in view throughout. Thus, the results obtained, which may some day lead to the evolution of a theory, serve in the meantime to establish facts of much value to practical constructors. The degree of fixity to be allowed for in the expression of the bending moment and in the design of reinforcement for resistance to negative bending moments is one of the most delicate questions for consideration by the designer. While the ends of reinforced concrete beams as usually applied are not supported freely, the condition of perfect fixity is rarely attained. Therefore the observations made relative to the extent to which the ends are fixed under various practical conditions are of high interest. One of the most remarkable points brought out in the course of the investigation is the fact that the resistance of beams stiffened by gussets or knee braces at the ends is seven times greater than that of beams uniform in cross section throughout.

Life in Epigram

By Ernest O'Neal

Reputation is seeming; character is being.

Reputation is manufactured; character is grown.

Reputation is your photograph; character is your face.

Reputation makes you rich or poor; character makes you miserable or happy.

Reputation is what men say you are; character is what God knows you are.

Reputation is what you need to get a job; character is what you need to keep one.

Reputation is what comes over you from without; character is what rises up from within.

Reputation is what you have when you come to town; character is what you have when you go away.

Reputation is what is chiselled on your tombstone; character is what the angels say about you before the throne of God.

Underground-Conduit Developments in Montreal

Substantial progress is being made in conduit construction in Montreal under the supervision of the Montreal Electric Commission, which was organized by an act of the Quebec Legislature of 1909 for the purpose of removing all overhead wires in the city with the exception of trolley contact wires. The commission consists of Dr. L. A. Herdt, of McGill University, chairman; Mr. R. S. Kelsch, representing the various public utility companies in the city, and Mr. de Gaspe Beaubien, representing the Quebec Utilities Commission, all being consulting engineers charged with the broad supervision of the problem of underground-conduit construction, the operation and maintenance of such structures, and the taking over of existing overhead lines and conduits in the establishment of a comprehensive system. The work being done at Montreal is one of the first instances where a municipality of 500,000 inhabitants has embarked upon a program of such scope upon the basis of a legislative act, and it is of particular interest in relation to the engineering and operating problems involved.

The members of the commission were appointed in 1911, and the first meeting of the board was held in the fall of that year. Additional powers necessary to give the commission complete control of the wire situation in the city were obtained from the Legislature in 1912, and the latter part of that year was occupied in engineering work involving studies of underground-conduit problems in Montreal and elsewhere and the preparation of plans, specifications and contracts for the initial installation. Construction was begun in the spring of 1913, and at present work is being pushed along the two major axial thoroughfares of the city, St. Catherine and Bleury Streets. About 687,000 feet of duct have been laid in the former and 180,000 feet in Bleury Street and Park Avenue. In general the main conduit consists of 3½-in. square tile duct, 3½-in. fiber duct being used in the construction of the laterals and services. The district at first to be covered consists roughly of an area about 3.5 miles long and 1 mile wide, including the business center and adjacent residential sections.

The commission will lease its ducts to utility companies upon a duct-feet basis not yet announced, and similar systems of transmission and distribution will be placed in adjoining ducts. The rental will be set at a figure which will cover all fixed and operating charges on the conduit system. An initial appropriation of $5,000,000 has been granted the commission, and all plans and specifications are approved by the Public Utilities Commission of Quebec before the award of contracts. The last-named body also acts as a board of arbitration in case of an appeal by any party in interest. Neither the city nor any company has the present right to install overhead wires, the Electrical Commission having sole jurisdiction over all wire and conduit work. It is believed that this arrangement will greatly reduce the burden of street openings experienced in cities of large size in which conduit is installed and maintained by the companies.

Plans are now being prepared in the offices of the board for placing underground wires throughout the entire business district. In general, three types of manholes are to be used—drain manholes, placed at street crossings and intersections; service manholes, usually 250 ft. apart, and containing connections for from two to six service pipes, depending on the demands of the local buildings, and transformer manholes. A maximum of thirty-two ducts per conduit has thus far been installed, and it is expected that cable pulling will begin early in the present month. The Bell Telephone Company of Canada maintains its own system of conduits by a charter provision, but all other utilities, including the local railway, power, telegraph and signalling systems, are to lease appropriate space in the city duct system. Contracts are awarded for various sections of the work upon a purely competitive basis. Occupants of buildings taking service from the companies using the ducts are required by ordinance to have their buildings wired to permit an underground service entrance in each case.

Three years ago, when the White Star liner Olympic entered the North Atlantic service, the only drydock in the world capable of taking her was at Belfast. Now there are five, all of them in British territory, namely, at Liverpool, Southampton, Bombay, Singapore and Belfast, while in another year or two there will be three in Canada, at Esquimalt, B.C., Halifax, N.S., and Quebec.

Personal Mention

Mr. A. W. McConnell has received an appointment as Assistant Professor of Architecture in the University of Toronto.

Mr. R. L. Dobbin was appointed recently to the position of waterworks superintendent for the city of Peterboro, Ont. He has been identified with water supply undertakings in various parts of Canada and was associated with the construction of the Moose Jaw supply line from Caron, Sask.

Major R. W. Leonard has retired from the National Transcontinental Railway Commission, after a service of two and one-half years. An Order in Council has been passed transferring the duties of the Commission to the Minister of Railways, in accordance with a recent Act of Parliament.

Mr. Thomas H. Hooper has been appointed operating superintendent of waterworks at Winnipeg. He will have charge of water distribution, care of mains, connections and services, and all repairs. For nearly fifteen years Mr. Hooper has been manager and chief clerk in the city's engineering department.

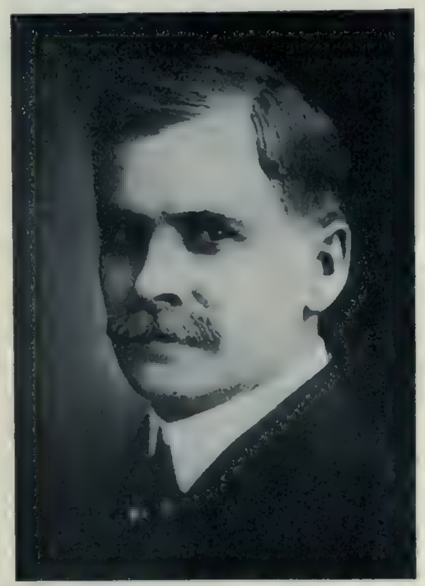
Mr. A. N. Johnson, Chief Engineer of the Illinois Highway Commission, has resigned to accept a position on the Bureau of Municipal Research at New York. Mr. Johnson is a member of most of the prominent American engineering societies. He has taken a great interest in convention work and many of his papers have been reproduced from time to time in the columns of this journal.

Mr. Paul Schioler has been appointed bridge and structural engineer of Winnipeg in the newly organized engineering department. Mr. Schioler was an assistant engineer on the Panama Canal in 1905-6 and in the following year was resident engineer on an important engineering undertaking in South America. He was assistant engineer in the Department of Public Works of Manitoba from 1907-8. In the latter year he entered the service of the city, since when he has been engaged in bridge construction work.

At the 24th Annual Convention of the Canadian Electrical Association held in Montreal (June 24 to 26) the following officers were elected for the ensuing year: President, Col. D. R. Street; First Vice-President, Mr. D. H. McDougall; Second Vice-President, Mr. R. M. Wilson; Third Vice-President, Mr. Wills MacLachlan; Honorary Secretary, Mr. T. S. Young; Secretary-Treasurer, Mr. Alan Sullivan, Toronto. Managing committee:—Messrs. J. S. Gould, Smith's Falls; G. W. Magalhaes, Toronto; P. T. Davies, Montreal; H. G. Matthews, Quebec; A. E. Dunlop, Pembroke; J. S. Norris, Montreal; George Kidd, Vancouver; Robin Boyle, Niagara Falls; W. G. Angus, Hamilton; W. S. Robertson, Toronto; E. L. Milliken, Sydney, N.S.; L. W. Pratt, Hamilton; H. R. Mallison, Montreal; H. Hulme, Montreal.

Mr. Bion J. Arnold, Chicago, Ill.

NOT a few of our readers will be interested in an informal introduction through this column to Mr. Bion J. Arnold, consulting electrical engineer, of Chicago, whose report on "The Traction Improvement and Development of the Toronto Metropolitan District" and whose valuation of the Toronto Street Railways are matters of recent history. Mr. Arnold was born in Michigan in 1861 and was educated at the University of Nebraska and at Hillsdale College (Mich.), taking a post-graduate course at Cornell University. After acquiring a general experience in the various branches of engineering work, Mr. Arnold turned to the field of electricity and decided upon making that his particular profession. He has devoted his attention largely to the construction and operation of electrical railways in which he has accomplished numerous distinct advantages. Being early impressed with the value of storage batteries in connection with electric traction work, he set himself to perfecting plans for their use. One of his earliest successes in pioneer electric railroading was the equipment of the Chicago and Milwaukee electric railroad with a sub-station storage-battery and rotary converter system, using high tension alternating current for power transmission, which proved a great success and has since become the standard type of construction for inter-urban electric roads, having reached its highest state of development in the system put into operation by the New York Central Railroad. That road commissioned him in 1901 to study and report upon the feasibility of electrically operating its trains in and out of New York City, and for the five years following he was a member of the commission in charge of electrifying over three hundred miles of the road's track, which, with the terminal in New York City that the changes necessitated, involved an expenditure of over $60,000,000. In 1902 he was engaged by the city of Chicago to make an exhaustive study and report upon the entire traction system within its limits and in four months he produced a 300-page report embodying a scientific analysis of the entire proposition so complete with arguments and statements of facts that his recommendations were adopted and formed the basis of a comprehensive system of surface, elevated and underground railways later developed by him as chief engineer.



Mr. Bion J. Arnold, Consulting Engineer, Chicago.

During the last decade Mr. Arnold has been called in to report upon some of the most difficult traction situations and transportation problems in the United States. Coming down to recent times, he was engaged in 1910 to report on the Pittsburg transportation problem. As chief subway engineer for Chicago he prepared and presented plans for a passenger subway system for the city. Los Angeles, Providence, San Francisco, and many other cities too numerous to mention have requisitioned his services. One of his most complete reports—the preparation of which involved over a year's work, was on "The Improvement and Development of the Transportation Facilities of San Francisco." Last fall, Mr. Arnold was engaged by the Citizens' Terminal Plan Committee to report on the steam railway terminal problem of Chicago and his recommendations constitute what is probably the most complete study of the kind ever made. Mr. Arnold continues to act as Chairman of the Board of Supervising Engineers of Chicago Traction. In this capacity since 1907 he has directed the expenditure of some $85,000,000 by the surface street railway lines of Chicago.

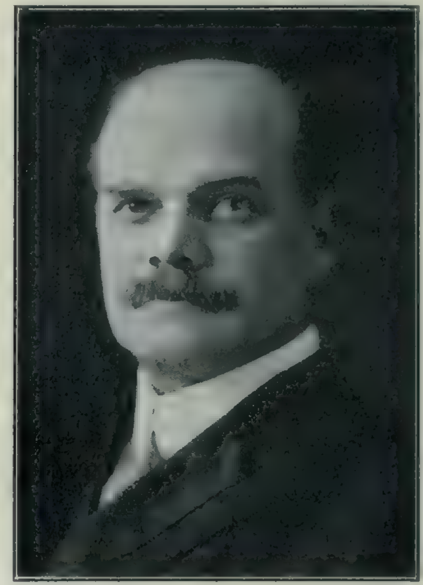
J. W. Evans, Belleville, Ont.

THE present City Engineer of Belleville, Ont., Mr. J. W. Evans, is one of the city's own sons, he having been born there in 1870. He was educated at the Belleville and Trenton public and high schools and at the School of Practical Science, Toronto. Mr. Evans proceeded to the study and practice of his profession under Mr. John D. Evans. From 1890 to 1893 he was Assistant Engineer for the Canadian Copper Company, Sudbury. Upon giving up this work he practised engineering for three years in the firm of Mickel & Evans. From 1896 to 1898 he was Chief Engineer of the Brandon and South Western Railway Company in which capacity he undertook the preparation of plans and surveys on the line from Brandon to Deloraine and Waskada. His experience was broadened by putting in a couple of years in charge of construction for the contractor of the Central Ontario Railway extension from Ormsby Junction to Bancroft. He was Chief Engineer of the Bay of Quinte Railway for six years and was also Resident Engineer of the Rathbun Company and Town Engineer of Deseronto. In 1903 he built the line from Napanee to Deseronto, and, in the two years following, that from Tweed to Bannockburn. Mr. Evans was engaged in the private practice of his profession at Cobalt from 1906 to 1910, and at Belleville, in the firm of Evans and Evans, from 1910 to 1914. He was appointed City Engineer of Belleville and manager of the waterworks there in April last.

City Engineer Evans, of Belleville, Ont.

Professor Brydone-Jack, Winnipeg

ONE of the best-known men in the profession in Western Canada at the present time is Ernest Edmund Brydone-Jack, Professor of Civil Engineering in the University of Manitoba. His academical post would appear to be a fitting avocation for the son of a former president of the University of New Brunswick. Professor Brydone-Jack was born at Fredericton in 1871. He graduated from the University of New Brunswick with the degree of B.A. in 1891 and from the Rensselaer Polytechnic Institute (Troy, N.Y.) with that of C.E. in 1894. Passing over a varied experience in railroad work, bridge work and general designing, we find him Professor of Civil Engineering and Dean of the Engineering Faculty in the University of New Brunswick from 1901 to 1905, during the greater portion of which period he held the office of City Engineer of Fredericton. He became engineer-in-charge of detail designing for the Virginia Bridge & Iron Works and later accepted an appointment as Professor of Civil Engineering in Dalhousie University at Halifax, N.S. He was engaged in private consulting work from 1905 to 1907, during which period he was Secretary-Treasurer of the Nova Scotia Society of Engineers. He succeeded to his professorate at the University of Manitoba in 1907 and has carried on private consulting work in conjunction with his academical duties from that time to date. The wide scope of Professor Brydone-Jack's activities may be gathered from the fact that he was Chairman of the Traffic and Transportation Committee of the Winnipeg Town Planning Commission in 1911; that he was a member of the Council of the Canadian Society of Civil Engineers from 1910 to 1913; that he was Secretary of the Manitoba Branch of the Canadian Society of Civil Engineers from 1907 to 1913; that he is the present chairman of the Manitoba Branch of the Canadian Society of Civil Engineers; that he has held a seat on the council of the University of Manitoba since 1910; that he is a member of the Province of Manitoba Board of Examiners of Architects, and that an enumeration of many more of his associations might be made. He holds membership in the Institute of Civil Engineers of Great Britain, in both the Canadian and American Societies of Civil Engineers and in the American Institute of Consulting Engineers.

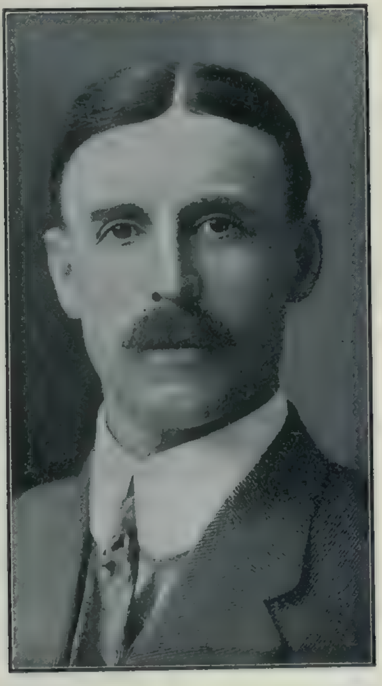

Mr. E. E. Brydone-Jack, Consulting Engineer, Winnipeg, and Professor of Civil Engineering in the University of Manitoba.

Mr. William F. Farley has opened an office at 43 St. Francois Xavier street, Montreal, where he will conduct a general engineering practice. Mr. Farley was formerly Assistant Engineer with the Ambursen Hydraulic Construction Company of Canada, Limited, and the Raymond Concrete Pile Company of Canada.

Mr. M. J. Butler, President of the Canadian Society of Civil Engineers, and Mr. P. A. Gagnon, accountant, have been appointed by the Montreal Board of Control to report on the proposed expropriation by the city of the Montreal Water and Power Company's system.

Strong Contracting Organization at Saskatoon

A new Western engineering and general contracting organization is the firm of Richardson Builders, Limited, Saskatoon. Brief mention of this company will be found of interest owing to the fact that the members of the firm are well-known Western men who have gained distinction in other capacities. The personnel of the company is Mr. E. A. Richardson, president; Mr. G. T. Clark, vice-president and engineer; Mr. Chas. Curtis, secretary, and Mr. Henry J. Keith, treasurer. The president, who hails from Nova Scotia, was formerly superintendent for the Geo. H. Archibald Construction Company, of Winnipeg, for whom he had charge of a number of important contracts, including the Maple Leaf flour mill at Kenora, Ont., the Western Canada flour mill at St. Boniface, Man., and the $250,000 departmental store of J. F. Cairns at Saskatoon. Later he became City Commissioner at Saskatoon, but resigned in favor of the more congenial office of President of Richardson Builders, Limited. Mr. Clark is known to many of our readers as the former city engineer of Saskatoon, he having held that post from 1909 to 1914. He severed the city connection to become general manager of Western Pavers, Limited, an office which he retains together with his vice-presidency in the Saskatoon company. The Secretary, Mr. Chas. Curtis, is well-known as a former Toronto man and as President of Western Pavers, Limited. The Treasurer, Mr. Henry J. Keith, holds similar office in Western Pavers, Limited. The firm received signal encouragement in obtaining the first work upon which they tendered—and not at the lowest figure, either—the contract for the students' residence of the University of Saskatchewan, at Saskatoon. The contract for this building was awarded to Richardson Builders, Limited, at $185,000 and the work will be finished at Christmas. It is the firm's intention to specialize on government and civic work, office buildings and warehouses. In predicting a successful business future for this new organization, we do so confident in the enterprise which has made individual successes of its members in the past.



Mr. E. A. Richardson, President Richardson Builders, Limited, Saskatoon.

Mr. Geo. T. Clark, Vice-President Richardson Builders, Limited, Saskatoon.

Obituary

Mr. M. M. Reynolds, Vice-President of the Grand Trunk Railway, and who for many years had charge of the financial and accounting departments, passed away recently.

Mr. E. S. Morrison, who lost his life recently in the Fraser River, B.C., at a point one hundred and forty miles north of Kamloops, was engaged as resident engineer of construction for the Canadian Northern Railway at Blue River.

Mr. T. H. Parr, whose death is announced at the age of 66, was a native of England and entered the engineering department of the city of Winnipeg after coming to Canada. He was engaged in private practice as civil engineer and surveyor at Victoria in 1890 and two years later was appointed assistant city engineer of that city under Mr. E. A. Wilmott, a position which he held for many years. For some time prior to his death the late Mr. Parr was not actively engaged in the pursuit of his profession.

Mr. Alexander Stewart, formerly assistant chief engineer of the Great Northern Railway, died in Seattle, Wash., recently. Mr. Stewart was born in Dalhousie, N.B., and his first position of importance was that of provincial surveyor of Manitoba. Later he was appointed chief engineer of the Duluth & Winnipeg road, now the Great Northern, with headquarters at Winnipeg. He went to Seattle in 1904 as assistant chief engineer, a post which he held until recently when, following a serious illness, he was appointed consulting engineer to be at hand on all important projects.

Mr. James L. Taylor has transferred his services from the position of road superintendent for the County of Wentworth, Ont., to a similar post in Parry Sound.

Vancouver Reports "Gradual but Perceptible Improvement"

Office of the Contract Record,
Vancouver, July 2, 1914

TO those who are at all familiar with current conditions in the constructional field at Vancouver and other important Pacific Coast points, the second half of the present year holds out the promise of a gradual but perceptible improvement in the building situation. After many protracted delays, arrangements have been practically concluded for starting operations on a number of outstanding projects of high valuation, chiefly in the neighborhood of Vancouver, and it is safe to assume that the additional activity thus created will have a decidedly beneficial effect on the general outlook for development work in this province. It is a significant mark of confidence in the future of the territory in which it operates that the B. C. Electric Railway Company, the largest single corporation in the province, is preparing to increase its transportation facilities by undertaking the construction of immense new car barns at Vancouver at an expenditure of fully $350,000. Another indication of confidence in the stability of the commercial capital is provided by the decision of the Canadian Bank of Commerce to proceed with the erection of a new branch office building, costing about $75,000, in the east end of the city. In addition to these extensive undertakings, contracts have either been let recently, or will be awarded shortly, for the construction of the first unit of the new University of British Columbia, costing about $500,000; three new post offices with an aggregate cost of $385,000; addition to the Vancouver General Hospital costing $75,000; Central School at North Vancouver, to cost over $116,000; Grandview drill hall, representing an outlay of over $350,000, and a number of other important structures.

IMPORTANT VANCOUVER PROJECTS

Tenders Invited for University Unit

The recent action of the Board of Governors of the University of British Columbia in calling for tenders for the first unit of the proposed constructional scheme was hailed with satisfaction in Vancouver building circles where the impression appears to exist that proposals will soon be invited for additional sections of the work. The initial construction planned in connection with the University group is the Arts and Science building, for which there is an appropriation available of $500,000. According to an announcement from Hon. Dr. Young, Provincial Minister of Education, it is the intention to invite tenders at an early date for two Dormitory buildings and an Administration building, the total outlay on all four structures approximating $1,500,000. All of the buildings will be reinforced concrete structures—the design of Messrs. Sharpe & Thompson, architects for the University.

In all probability a permit will be issued at Vancouver during July for a three-storey branch building which the Canadian Bank of Commerce propose to erect this year on their property at the corner of Main and Pender streets. It is understood that plans of the structure disclose columnar treatment on the two street frontages which are to be constructed of stone. Brick will be used for the two remaining elevations. Provision has been made for offices in the upper storeys and the cost of construction will be approximately $75,000.

Construction work is proceeding steadily on the new addition to the Vancouver General Hospital, known as the McGill Block, to be used for the present by the authorities of McGill University and to be utilized later for hospital purposes. The building measures 150 x 50 feet and will be three storeys in height. It is of reinforced concrete and brick construction, representing an outlay of about $75,000, and it is being erected by Booker, Campbell & Whipple, after plans by Mr. A. A. Cox, Vancouver.

Work is now in progress in connection with the new car barn which the B. C. Electric Railway Company is erecting at Vancouver between Main and Quebec streets. The company owns an entire block of land at this location and has a car barn on the north half with accommodation for sixty cars. The new building, which will occupy the southern portion of the block, will be two storeys on Main street and one storey on Quebec street, the lower elevation on the latter street being possible on account of a rise in the grade. The new structure will provide for one hundred and twenty cars, thus enabling the company to take care of one hundred and fifty cars at one point. The interior dimensions of the barn are 130 x 304 feet. It will be of reinforced concrete throughout and is estimated to cost about $350,000. As the ground is low lying, the entire building will be constructed on piles, and the building will be erected one-half at a time. The excavation for the southern half is already completed and retaining walls extending along the Quebec Street and Fourteenth Avenue frontages have been erected. About 25 per cent. of the piling is in place and operations are progressing for the footings of the concrete piers. Westinghouse, Church, Kerr & Company are the contractors and architects for the work.

SCHOOL CONSTRUCTION PLANNED AND UNDER WAY

Provincial Normal School a Noteworthy Building

The Provincial Normal School at Victoria, upon which work has reached an advanced stage, is without exception the most noteworthy example of school construction in British Columbia. The building occupies an ideal location on a seven-acre tract at the corner of Richmond and Lansdowne Roads, and is being erected with a view to providing the province with an establishment where the educational facilities and general equipment will equal that of any similar institution in the country. The general contract for this work was awarded to Luney Bros., of Victoria, in the latter part of June, 1913. Since the commencement of active construction last July, the progress of operation has been all that could be desired, despite the time occupied at the start in excavating the foundations from solid rock. The structure will be thoroughly fireproof, it being of reinforced concrete construction with facing of red pressed brick and trimmings of Denman Island stone, with slate roof. The most commanding feature of the design is a central clock tower, 95 feet in height, whose base merges into the elevation of the principal entrance. The main entrance will be finished in terrazzo tile and the interior of the auditorium will be carried out in plaster decorations. The stone work on the exterior has been practically completed by the contractors, who, at the same time, have the slating and plastering well in hand and are about to commence operations in the interior of the building. The rock used in the concrete was the material taken from the excavation and crushed on the job.

Included in the equipment will be a system of low-pressure steam heat; exhaust ventilation; vacuum cleaning plant, gas plant, wood block floors throughout, automatic temperature control, electric time system, inter-communication telephone system, and a full equipment for the various rooms and departments on the different floors.

On the lower floor there will be a gymnasium, 73 x 35 feet, recreation rooms, heating and fuel chambers, store rooms, lavatories, bath and dressing rooms, plunge and shower baths for both sexes, luncheon rooms, masters' rooms, cycle rooms, games and storage rooms, janitor's rooms.

An auditorium, 73 x 35 feet, with gallery, platform, ante rooms, etc., four students' class rooms, three model scholars' class rooms, principal's and teachers' rooms, two music rooms, secretary's office, cloak and locker rooms, library, store and stock rooms, lavatories, etc., will occupy the ground floor.

On the first floor will be situated four class rooms, clay modelling, art, science, lecture and preparation rooms, optical dark room, biological, chemical and physical laboratories, balance and stores rooms, science master and assistant science master's rooms, lavatories, etc.

A feature on this floor will be a section devoted to the study of domestic science, including lecture room, a laundry, dressmaking and sewing rooms, cookery department, and a complete living suite, with two bedrooms, dining room, etc. On the first floor will also be rest and sick rooms, a room for medical stores, etc.

Mr. W. C. F. Gillam, of Vancouver and Victoria, is the architect for this fine school, the cost of which is expected to run into about $400,000. It is believed that the entire building will be completed well within the time limit specified in the contract—December 31 next.

The general contract for the proposed Central School building at North Vancouver has been awarded to W. J. Smith, Limited, Vancouver, whose tender amounted to $116,112. The design of this school, which was prepared by Mr. W. C. F. Gillam, of Vancouver and Victoria, provides for a structure 204 x 140 feet, consisting of reinforced concrete frame, brick and tile walls, with trimmings of Haddington Island stone, interior tile partitions and slate roof. The excavating contract is in the hands of Mr. F. McLellan, who has the work under way.

It is understood that contract tenders will be invited early in July by the Vancouver School Board for the first unit of the Strathcona School, which comprises a nine-room fireproof building, two storeys in height and of reinforced concrete construction with brick and stone facing. It was intended in the first place to erect a 24-room structure, but the original plans have been revised to provide for a 16-room building of which only a section, containing nine rooms, will be proceeded with at present. The amount of this contract will probably not exceed $80,000.

Competitive plans for a proposed 8-room fireproof school building are being invited by the Point Grey School Board and a number of the leading architectural firms in Vancouver have designs in course of preparation.

Luney Bros., of Victoria, were recently given the contract for the proposed Margaret Jenkins School at Hollywood, Victoria, the amount of their tender being $44,200. This building will be of the usual fireproof type with reinforced concrete frame, brick walls and stone facing.

The Victoria School Board has now available the sum of $155,000 for new construction work and it is quite probable that tenders for another new structure, the proposed Hillside School, will be called at an early date. According to the estimates of the board this school will represent an expenditure of approximately $80,000.

The municipality of Saanich, near Victoria, contemplate the construction of a new school and a by-law providing $45,000 for the purpose has been introduced in the local council.

PUBLIC WORKS DEPARTMENT CONTEMPLATES HEAVY BUILDING PROGRAMME

Leading Structures Described

Among the many important buildings projected in this province by the Dominion Department of Public Works are three sub-post-offices of substantial size and attractive design, two of which will be located in Vancouver, while the third is to be established in South Vancouver. Tenders closed at the end of June for erecting the proposed sub-post-office on the corner of 15th Avenue and Main Street in the Mount Pleasant district, Vancouver. This building will measure 73 x 88 feet and will be of reinforced concrete construction with stone and brick walls and marble wainscotting in the public space on the main floor. A marble staircase will lead from this floor to the offices in the next storey and the equipment throughout will be of the very latest description. The sum of $100,000 has been appropriated for the work, designs of which were prepared by Mr. A. Campbell Hope, Vancouver.

It is learned on good authority that plans are nearly completed for a new postal station and office building to be erected on the property recently purchased by the federal authorities at the corner of Gore and Keefer Streets, Vancouver. While there are no building details available at present, it is practically certain that the constructional features of this edifice will conform in a large measure with those of the Mount Pleasant structure, and that active construction will be undertaken this summer. The cost of this building has been estimated at about $250,000.

Plans are being prepared for the new South Vancouver post office which is expected to cost about $35,000. According to the limited details at hand, this will be a reinforced concrete building with brick facing and stone decorations.

According to Mr. R. F. Green, M.P., plans are under way for a new post office in Revelstoke and tenders will be invited immediately following the completion of the designs.

The Dominion Government intends to proceed with the construction of a new public building at Prince Rupert this year and has laid aside for the purpose a sum of $200,000. Tenders for this structure, which will be of reinforced concrete construction and five storeys high, closed on July 6. Granite will be used for the front elevteion and the remainder Granite will be used for the front elevation and the remainder are 100 x 100 feet. The ground floor will be paved in mosaic tile and terrazzo will be used for the three succeeding floors. Accommodation is to be provided for post office authorities, customs, telegraph, marine and inland revenue departments and for the Resident Engineer of the Public Works Department.

In point of size, cost and architectural beauty, the new drill hall which the Department proposes to erect in the Grandview district of Vancouver, is one of the most important works contemplated in the province. Messrs. Perry & Fowler, a Vancouver firm of architects, are responsible for the design of the building, tenders for which closed at the end of June. The construction will consist of brick and steel and the structure will have frontages on three streets with entrance on each. The extreme measurements are 278 x 174 feet and the cost has been estimated at something over $350,000. Adjoining the drill hall proper, a well-lighted apartment, measuring 225 x 120 feet on the main floor, will be company armories and officers' rooms. The first floor is to be occupied by the officers' mess, warrant officers' mess, sergeants' mess, lecture rooms and other quarters. The basement will accommodate swimming pool, gymnasium, miniature rifle ranges and bowling alleys, store rooms, etc. Accommodation is also provided in the building for the office of the brigadier and two band rooms.

Operations are expected to commence at an early date in connection with the proposed third class, reinforced concrete Detention Building to be erected by the federal government on Digby Island at Prince Rupert. This structure will be two storeys high and 200 feet in length and will be provided with accommodation for 100 people. Tenders for the work closed at Ottawa during the first week in July.

Building Prospects at Victoria

The contract for the first unit of the Royal Jubilee Hospital buildings at Victoria having recently been awarded to the B. C. Construction and Engineering Company, there seems every likelihood that tenders will be invited at an early date for the main section of the hospital and that construction work will be started some time this year on the main building scheme, involving an outlay of close to half a million dollars. The initial part of the work, for which the figure of the successful tenderers was $26,200, includes a brick power-house and laundry buildings. Tenders are new being taken for the erection of the power-house shaft, which will be 125 feet in height and of either brick or concrete construction. The hospital plans were prepared by Mr. Loring P. Rixford, of Victoria.

Another important contract—that for the proposed First Presbyterian Church—has been let to Stevens Bros., a local firm, their figure being $53,000. This building was designed by Mr. J. C. M. Keith.

Heisterman, Forman & Company are the owners of a block of six one-storey store buildings to be erected in the near future at the corner of Fort and Government streets at a cost of approximately $25,000. The outside measurements of the block, which will be of brick construction, are 60 x 60 feet. Mr. C. E. Watkins, a local architect, prepared the plans.

The municipality of Esquimalt, adjoining Victoria, intend to start work this summer on a municipal hall and firehall, building plans of which were prepared recently by Mr. Thos. D. Sedger, of Victoria. Construction work will be carried out in brick at a cost of about $25,000.

MAINLY CONSTRUCTIONAL

EAST and WEST — FROM COAST to COAST

EASTERN CANADA

For asphalt pavements at the Federal capital, the Ottawa Construction Company have secured a contract for work totalling nearly $100,000.

The American La France Fire Engine Company, of Canada, Limited, has been incorporated with $50,000 capital. The head office is in Toronto.

The Cadwell Sand and Gravel Company's plant has sustained a loss of about $8,000 in a fire which broke out in the Curling Club's building at Windsor, Ont., recently.

Campbellton Development, Limited, has been incorporated with a capital of $45,000 and head office at Campbellton, N.B., for the construction of public and private works.

The Hall Engineering Works, Limited, has been incorporated with chief office at Montreal and a capital stock of $200,000, to carry on the business of engineers and general contractors.

The Laval Quarry Company, Limited, was incorporated recently to carry on the building, contracting and manufacturing trades. The head office is at Montreal and the capital stock $49,000.

At Halifax, N.S., the construction of a mile of sea-wall 45 feet high from the bottom, and raised on two immense piers, is about to be commenced. The work will cost approximately five million dollars.

The incorporation of Gardiner & Gaskill, Limited, with a capital stock of $40,000 and head office at Montreal, is announced. The operations of the new concern will be those of general contractors and builders of railroads and bridges.

The building permits issued at Montreal during the six months ending June 30 last totalled $8,521,910, as compared with $9,942,285 for the corresponding period of last year. The June, 1914 and 1913 totals were $1,943,596 and $2,278,424 respectively.

The experiment of oiling the streets to lay the dust is about to be undertaken by the Fort William city council. With this object in view a carload of 50,000 gallons has already been purchased. The oil will be used on central streets which are not paved.

The Ontario Concrete Post Company, Limited, was incorporated recently with head office at Brantford, Ont., and a capital of $40,000, to manufacture reinforcements for concrete posts of all kinds. The provisional directors are David William Henry, Willoughby Staples Brewster, George D. Heyd, Alton L. Hanna, and May Senn.

At Halifax, N.S., the erection of a Science building for Dalhousie University is well advanced and it is hoped to have the building completed by September. The total estimated cost of the work is $150,000. The architect is A. R. Cobb, and the general contractors are Messrs. Falconer & McDonald, Halifax.

At Ottawa, foundation work has been completed on a store and apartment building estimated to cost $180,000, for Mr. Donald Fraser. The architects are Messrs. Horwood, Taylor & Horwood, 130 Sparks street, Ottawa. The contractors for the steel work are the Dominion Bridge Company. The building will be of solid brick construction.

At Quebec, operations are proceeding on the erection of a boarding school for the Good Shepherd Nuns. The building will be six storeys high, 137 ft. by 80 ft. in dimensions, and will cost $100,000. The architects are Messrs. Tanguay & Lebon, 20½ d'Aiguillon Street, and the general contractor is Mr. Ed. Belanger, 185 Ste. Marguerite Street, Quebec.

The Dominion Steel Company is carrying out a number of extensive orders at the present time, one of which is an important order for rails from the Canadian Northern Railway Company. The plant is working at maximum pressure and according to an announcement made a few days ago by an official of the firm, the works will be kept going night and day for the remainder of the year.

About $100,000 worth of buildings are being erected at Acadia, N.B., this year. A new three-storey building of brick construction, and somewhat larger than the building which was burned down some time ago, is in course of construction at the Acadia University. A library building is also being built together with a girls' dormitory. All three structures are expected to be completed this fall.

The city council of St. John, N.B., has passed a resolution favoring the provision of an incinerator for the city, the cost not to exceed $50,000. The commissioners of finance and of public works have been authorized to visit other cities where modern incinerators are installed, with a view to obtaining the necessary information as to the type of plant that would be most suitable for St. John.

At Fort William, Ont., the construction of a trunk sewer on Stanley avenue, in the west end of the city, which has been under way during the past two years, is being pushed forward rapidly. This sewer is being laid about 30 feet below the surface of the ground and it is reported that nearly sixteen lineal feet is being constructed daily. It is anticipated that with favorable conditions the contract will be completed this autumn.

At Fort William, Ont., tenders will be called in a few days in connection with the construction on the city hall square of a new Registry Office, plans for which have already been prepared. It is the intention to start building before August and to complete the building before the end of the present year. A five-storey business block of reinforced concrete is to be built on Brodie street for Messrs. Cameron & Company at an estimated outlay of $76,000. Tenders are at present being called for the work.

A movement is on foot at Fredericton, N.B., to establish a plant for the manufacture of concrete blocks, bricks, etc. With a view to obtaining first-hand information concerning the most up-to-date plants, Mr. T. C. Burpee, President of Concrete Builders, Limited, visited the principal cities of Canada, including Montreal, Toronto, London, and Ottawa, recently. The company has already purchased new machinery and it is their aim to inaugurate a concrete-brick manufacturing plant at Gibson, N.B., which will compare favorably with similar plants in other parts of the Dominion.

Reports from Fort William regarding the demand for bricks are very encouraging. It is stated that many thousands of bricks are being manufactured daily by the different plants. The Alsipe Brick & Tile Company are stated to be working to capacity and producing 70,000 bricks a day; the Fort William Brick & Tile Company some 26,000, and the Superior Brick Company about 35,000. At the new plant of the Mount McKay Products, Limited, a good deal of activity is also being shown in the construction of new kilns, although brick-making for commercial purposes will not be under way for some time.

The Union Block on the south-west corner of Adelaide and Toronto streets, Toronto, will be demolished shortly to make room for the new Excelsior Life office building. The following is a partial list of tenants who are removing to new quarters: W. T. Stewart & Son, roofers, Stevenson Building, 110-112 Church street; Don Valley Brick Works, New Dominion Bank Building, corner King and Yonge streets; Designing & Draughting Company, architects, 54 Adelaide street east; D. C. Cotton, architect, 54 Adelaide street east; Williams & Cole, engineers, 54 Adelaide street east; C. P. Bond, architect, 28 Toronto street; Bowman & Connor, engineers, 16 King street west.

The American Hoist & Derrick Company have removed their Seattle office from 613 Western avenue to 1512 L. C. Smith Building. This office is in charge of Mr. F. R. Schoen.

WESTERN CANADA

At Lethbridge, Alta., the Anglican church congregation under the Rev. Murrel-Wrighte contemplate the erection of a church, hall and rectory at a cost of $150,000. Plans have been completed by the architects, Messrs. Clemesha & Portnall, of Regina.

Plans are being drawn for a new postal station and office building at Vancouver at an estimated cost of $250,000.

The city of Regina has included in its estimates the sum of $380,000 for the installation of a power plant and extensions to the electrical distribution system.

At Victoria, B.C., an astronomical observatory will be established in the near future at a cost of $200,000. The station will be equipped with a 72-in. reflecting telescope.

The oil boom which started in Alberta some time ago seems to have reached Saskatchewan, six companies, with an aggregate capital of $2,000,000, having been organized in that province lately.

Calgary, Alta., has under construction this year 150,000 square yards of asphaltic concrete pavement, about 3,000 square yards of stone block and approximately 800 square yards of vitrified brick.

For an addition to the Royal Alexandra Hospital at Edmonton, estimated to cost $120,000, the contract has been awarded to the Zenith Construction Company. The architect is Mr. R. W. Lines, of Edmonton.

The foundation stone was laid a few days ago at Winnipeg for the erection of a new school at a cost of $190,000. The building, which will be known as the King Edward School, is to contain twenty-four classrooms.

A substantial deposit of silica sand was discovered recently near Redcliffe, Alta. It is said to resist a temperature of 3,000 degrees and to possess properties which indicate its suitability for clay products, iron works, etc.

Red Deer, Alta., is to have a new post-office building at a cost of $110,000. Tenders for erection are now being received by the architects, Messrs. Sharman, Barnes & Gibbs, of Red Deer and Edmonton. Bids close July 15.

Certain alterations required in the plans have brought about a cessation of work on the post-office and customs house which are being erected by the Dominion Government at Three Rivers, Que., at a cost of $225,000.

Work on the big interior elevator for the Dominion Government, at Saskatoon, is being pushed forward rapidly, and a large army of men is engaged in its construction as it is the intention to have the elevator completed in time to handle the forthcoming crops.

The contract for the erection of an elevator with a storage capacity of 30,000 bushels for the Dominion Elevator Company, is reported to have been received by the Harper Construction Company, Winnipeg, to replace the elevator which was burned down recently.

At Port Coquitlam, B.C., work has started on the erection of a bridge over the Pitt River. The structure is being erected by the Department of Public Works at a cost of $300,000. The general contractors are Messrs. Armstrong, Morrison & Company, Limited, Vancouver.

Revised estimates for extensions to the waterworks at Regina, involving an outlay of $250,000, have been adopted by the council of that city. The work comprises reservoir, wells, meters and pipe lines. The superintendent of the Waterworks Department is Mr. J. M. MacKay.

The new steel bridge which is being constructed across the Saskatchewan River at 25th street, Saskatoon, is not expected to be in operation before the fall of 1915. Eighteen carloads of steel arrived last month for use on the new bridge, the construction of which will involve an expenditure of nearly half-a-million dollars.

At Winnipeg, tenders are about to be called for the erection of the Engineering Building of the University of Manitoba. The estimated cost is $250,000. The plans were prepared by Mr. V. W. Horwood, 261 Fort street. Messrs. Brown & Vallance, Montreal and Winnipeg, are the consulting architects.

In connection with the recent oil boom at Calgary, Alta., it is reported that a company intends drilling for oil and gas near Aldersyde, convenient to a well which is at present producing petroleum gas at a depth of only 280 feet, and that the company will drill a number of wells until a flow of 400 feet of gas is obtained. Condensers of the Bessemer type will be installed for the purpose of extracting the gasoline.

Announcement was made recently by Mr. W. H. Willson, Secretary of the Board of Trade, that there is a possibility of an eastern corporation locating a steam plant in Calgary, Alta., in the near future. It is predicted that the directors of the company intend after they have got their plant under way to experiment along the line of non-expansion steam. The local board of trade has been active in the matter with the result that a possible site for the location of the plant has been purchased by a representative of the company.

The Vancouver and District Joint Sewerage Board will receive tenders until July 18 for the construction of trunk sewer mains at an estimated cost of about $350,000. This contract has reference to extensions of the China Creek sewer to Central Park with tributary mains to Gladstone, Collingwood and Earls Road districts, and a separate trunk sewer to Trout Lake. Another contract, which is under way and will probably be completed next November at a cost of $250,000, relates to the China Creek and Canoe Creek mains and a portion of South Vancouver.

The Dominion Government has selected a site for the erection of a transfer elevator to be built in Vancouver at an estimated cost of from $750,000 to $1,000,000. Plans will be prepared without delay and tenders will be invited for the structure in a month or so. The elevator is to be built on a site situated on the government dock in Vancouver Harbor. It will furnish facilities much needed by the Pacific coast but claimed to be especially valuable in view of the opening of the Panama Canal, besides completing a chain, extending from east to west, of interior storage elevators now being built or under contract in Calgary, Saskatoon, Moose Jaw and Fort William.

The feasibility of encouraging the establishment of an iron and steel industry at Vancouver, B.C., was reported upon recently by the mining committee of Vancouver board of trade. There is still an ample supply of raw material in the form of magnetite ore at Texada, Nelson, and other islands, as well as on the east and west coast of Vancouver Island. Other kinds of ore are also reported to be present in abundance in different parts of Vancouver Island but there are no known deposits of iron ore of commercial value on the Pacific coast south of British Columbia.

At Victoria, B.C., a 7,000-ton floating dry dock owned by the Seattle Construction & Dry Dock Company has been leased to Messrs. Grant, Smith & Company, contractors, for use in connection with the construction of a breakwater in the outer harbor. Fifty-four caissons will be built, two of them being constructed simultaneously upon the dry dock. The weight of each will be about 3,500 lbs. As the concrete piers are being built the dry dock will be allowed to sink as the construction of the piers advances. Upon completion they will be held in suspension by cranes during their removal, after which they will be fixed in place. The water level is regulated by means of watertight compartments in the bottom and sides of the dry dock.

Information received at this office reports that building operations at Saskatoon, Sask., are quite active just now. A number of important buildings are in course of construction and there is a marked increase in the permits taken out for residences. A large store and office block, a cold storage warehouse, and a distributing warehouse (for the Prairie City Oil Company) figure prominently among the business permits taken out in June. In addition, the Canadian Townsite Properties Limited, have commenced the excavation of a basement upon which it is their intention to erect a business block. A new sedimentation basin is being constructed by the city council near the filtration plant, while the construction of an additional students' residence at the University of Saskatchewan is well under way. It is estimated that about $300,000 will be spent in additions to the University during the present year.

Coming Events

The annual meeting of the Ottawa Branch of the Canadian Society of Civil Engineers will be held in the Federal Capital on the first Wednesday in October.

The Royal Architectural Institute of Canada will hold its seventh annual meeting at Quebec, September 21-22. The Hon. Secretary is Mr. Alcide Chausse, 5 Beaver Hall Square, Montreal.

The American Road Builders' Association will hold their annual convention, good roads congress and exhibition of machinery and materials in Chicago, September 14-18 next. The Secretary is Mr. E. L. Powers, 150 Nassau Street, New York.

The annual convention of the Union of Canadian Municipalities is to be held at Sherbrooke, Que., from August 3-5 next. The Hon. Secretary is Mr. W. D. Lighthall, of Westmount, Que., and the Assistant Secretary is Mr. G. S. Wilson, 402 Coristine Building, Montreal.

Unusual Conditions at Main Pumping Station, Toronto

Unusual conditions were disclosed upon an examination at the city's pumping station of the centrifugal pumps which had been reported inefficient by the Works Commissioner. It was found that the revolving wheel of the pump was choked with wood and that a considerable quantity of sand completed the trouble. The charge in reference to the pumps, so far from being sustained, has completely vindicated them on the score of construction, capacity and efficiency. In 1912 an official test was made by the civic officials, the Hydro people testing the electrical end, when it was found that the capacity and efficiency were above the guarantees. The pumps were installed by the Jens Orten Boving Company, of London, Eng., the contract dating back to 1909.

The Missisquoi-Lautz Corporation, Limited, Philipsburg, Que., have issued a neat folder to architects dealing with Canadian marbles. The Missisquoi marbles are claimed to be the standard marble for government, bank and office buildings, lending themselves harmoniously as they do to any color scheme. Missisquoi marble was used throughout in the interior decoration and construction of the Alberta Parliament Buildings at Edmonton, and in this connection special reference was made recently to the excellent effect by Sir Gilbert Parker, a well-known member of the Imperial House of Commons. The approach is dignified, forceful and strong. It has individuality which reflects the character of the province and the people of Alberta.

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Alphabetical Index of Advertisers
Page 16

Vol. 28 July 15, 1914 **No. 28**

Principal Contents

A Canadian Town-Planning Revival 887-8
Sterilization of Water by Ultra-Violet Rays 888
Interesting Bridge Work in British Columbia 889
Regulations Governing Plans for Waterworks and Sewerage 890-3
The Fundamental Principles of Aesthetic Bridge Design 894-6
Disinfection of Sewage and its Success in a Small City 897
By Frank A. Nikirk
Sewage Disposal for the Country Home 898-9
By Benjamin Brooks
Management Engineering Applied to a Highway Contractor's Organization 900-1
By Henry B. Drowne
Don Section, Bloor-Danforth Viaduct, Toronto 902
Road Designing 902-3
By Robert A. Meeker
An Analysis of Worn-out and Ravelled Macadam Surfaces, with Suggestions as to Treatment 904-5
Grades and Leakage in Intercepting Sewers 906-7
Softening Water Supplies 907-8
Toronto Union Station Contract Award 908-9
Proposed Registry Office, Toronto 909
St. Michael's R. C. Church, Montreal 910
Constructional, Personal and Industrial News 913-6

A Canadian Town-Planning Revival

IN a day when town planning and civic improvement generally are receiving such specialized study in Europe, it is gratifying to learn that the Dominion Government is awakening to a sense of its responsibilities in this connection, and that Mr. James White, Assistant Chairman of the Conservation Commission, has been sent to England to consult with the town planning experts of the Local Government Board with a view to introducing a better system of town planning in Canada.

With the example of the older countries before us there is no excuse for further bungling, neither can there be any justification for attempting to defer the larger responsibilities. During the last few years a great deal has been written and much more said about town planning and civic improvement schemes, but for the most part the discussions have been "such stuff as dreams are made of." There has been little or no practical work—nothing that can be translated into terms of dollars and cents.

Even in Western Canada, with its rapidly-growing towns which have been cited as examples for the East, the lessons of the older cities have not been learned. Large blocks of land have been held by real estate men and subdivided independently of any town system. The development of these western places is characterized by Mr. White as having a "chequerboard monotony." Such monotony is inimical to the best interests of a people. A community which grows up in the midst of deadly dull similarity grows up without ideals—becomes sordid, depraved.

As for the "great" cities of Eastern Canada, the less said about their planning, or rather lack of planning, the better. It is almost inconceivable that Toronto should have developed into a city approaching half a million people and continued to build upon the lamentable errors and lack of foresight of earlier generations. Except in regard to its natural location and natural advantages, the "Queen City" is a misnomer for Toronto. The narrow streets, the miserable transportation arrangements, the proximity of disreputable tenements to large commercial buildings, the lack of open-air spaces, and the tendency to convert the central portion of the city into gloomy canyons by the erection of "skyscrapers"—all these things are lamentable in the extreme and can be condoned only by those whose lives are concentered in their own personal aggrandisement.

As a people we are too apt to be influenced by the cheap eulogiums handed out to us by American and other tourists. Our cities are not what they seem—are not what they should be.

In opposition to the policy of taking immediate action, it is urged that any thorough reform would require a large loan beyond the borrowing power of Canadian municipalities—at least beyond their power during the present state of financial conditions. But several English towns have shown us by actual experiment that these reforms have cost less money than

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TUESDAY MORNING, 10 O'CLOCK—We direct the attention of our readers to a matter of importance. It has reference to the day, and time of day, the Contract Record goes to press. Last week we received a tender advertisement too late for insertion. This meant serious loss to three classes of our readers (to say nothing of ourselves,—the municipality, the dealer and the contractor. The Contract Record goes to press every TUESDAY, and 10 O'CLOCK of that day is the latest we can be sure of getting tender advertisements in. We therefore make a special request that our readers bear this date in mind—TUESDAY, 10 O'CLOCK. Many magazines come out later in the week, but we have always believed that the interests of our constituents are best served by placing the news before them as early in the week as possible. Once more we ask you to bear it in mind—TUESDAY MORNING, 10 O'CLOCK.

has been entailed in maintaining old conditions. As one outstanding example of the truth of this, Mr. White cites the Kingsway, that magnificent modern thoroughfare which runs from Holborn to the Strand, in old London. Here, not only was the street expropriated but the abutting property as well, and when the improvements had been made it was resold at a considerable profit, the returns coming in before the hardship of borrowing had been felt. While we have been discusing the unsurmountable difficulties attendant upon our little problems, London has taken hold of a great task and secured the benefit of increased land value—leaving us pondering still.

Towns such as Hampstead and Port Sunlight in England have met with much success in securing the maximum of air space and avoiding the evil of tenement houses. On the larger scale, London, Paris, Berlin and other cities have undertaken schemes the consummation of which will involve the efforts of generations and the expenditure of millions upon millions.

It is pretty generally known that the newly-formed Town Planning Association of Canada is drafting an Act to be presented to the various provincial legislatures for approval. [It may be of interest to recall Mr. R. O. Wynne-Roberts' criticism of the first draft of this Act, published in our issue of July 1.] Mr. White's report is to be laid before the Conservation Commission in the fall and will serve as the basis of recommendations from that body to the Federal Government. It is to be hoped that it will embody such suggestions, as, put into effect, may tend to compensate for the grievous mistakes of the past.

Contract Procedure—The Deposit Cheque

TENDERING on the construction of some paving work, a Toronto contractor submitted a price $5,000 below the bid of the Works Department and $7,000 lower than that of the next regular contractor. Later he pleaded a mistake in the preparation of his tender, and asked either that the contract should be given to him at the Works Commissioner's price of $46,000 or that his deposit cheque should be refunded. The Board of Control recommended that the deposit cheque should be refunded, and the recommendation was endorsed, despite the unqualified disapproval of the Mayor, who, however, stood alone in his opposition. The Mayor contended that the principle favored by the Board of Control was a vicious one, in that it encouraged collusion among contractors. Was he right?

Crop Reports Encouraging

WE learn that the crop situation in Western Canada never looked better than it does to-day. Perfect weather for seeding, followed by the best of growing weather during the spring months, with plenty of rain coming at just the right time all over the three prairie provinces, has created an atmosphere of jubilant satisfaction among the farmers. This together with the increase of over a million acres in the area under crop in wheat, oats and barley, and the resultant prospects of a bumper crop, forms sufficient basis for the feeling of optimism which prevails among all classes of business as regards the fall trade. This feeling is not confined to any one class of business men, but is most pronounced among those who have the greatest facilities for getting into close touch with the agricultural situation. The building situation in Winnipeg continues to improve, the total building permits for the past six months being within measurable distance of the record year, 1912, and surpassing the total for the similar period of 1913 by over half a million dollars. The totals for the six months ending June 30 last show a valuation of $10,082,400. The first six months of 1913 totalled $9,558,850. In 1912, the biggest year on record for Winnipeg building, June 30 showed a total for the first six months of $11,487,150. For the month of June last, the total value of permits issued was $1,560,200, as against $1,875,800 in 1913. In the building trades, and in contracting generally, there is an ample supply of labor.

Sterilization of Water by Ultra-Violet Rays

A paper on the sterilization of water by ultra-violet rays of the mercury vapor quartz lamp was given by Mr. von Recklinghausen, Director of the Westinghouse Cooper-Hewitt Company, Paris, France, at the annual Convention of the American Institute of Electrical Engineers held last month in Detroit. It is found that all the dangerous bacteria, and all their spores succumb to the ultra-violet light, if exposed to it strongly enough, for even a fraction of a second. To obtain the use of all the light, the lamp must be surrounded by the water, but it is found that if the water comes in contact with the tube of the lamp itself, the activity is greatly reduced. Also since glass is opaque to the ultra-violet rays, only quartz can be used between the tube and the water. Stirring up the water in its passage through the tank is necessary, to prevent the bacteria from hiding behind particles of the matter in the water and escaping. The largest plant now in use is at Luneville, France, and has ten lamp equipments. The water as fed to this outfit, has a germ content, sometimes as high as 1,000 per c.c.; on leaving, the bacterial content is reduced down to from 0 to 10. There has been a great reduction in the typhoid death rate in this place, the old rate ranging from 70 to 160, balanced against almost no deaths at all, at the present time. The energy consumption is very small; the largest lamp in use takes but 2½ amperes at 500 volts. From 50 to 130 kw.hr. per million gallons is a liberal estimate of the power necessary. In answer to questions which came out in the discussion, Mr. von Recklinghausen estimated the cost at about 80c per million gallons, including power at 1c per kw.hr. and lamp renewals at 30c per million gallons. The water must not be too turbid, so that the light will be too soon absorbed by it. The Luneville plant has been in operation three years, and purifies 200,000 gallons a day.

Covers for sprinkling filters are required at the sewage-treatment plant in Aberdeen, S. Dak., on account of the severity of the winter weather. As described by W. G. Potter in a paper presented at the June 15 meeting of the Western Society of Engineers, concrete piers, 13 ft. apart, were built between the sprinkling nozzles and extended to a height of 6 in. above the surface of the crushed stone to form supports for a wooden framework. On the concrete piers 4 x 4-in. wooden posts were erected with 4 x 6-in. stringers between them. On this framework a temporary winter cover of 2-in. plank is laid. The plank cover only will be removed during the warm season, the framework being left in place, although this framework is so built as to be removable without drawing a nail. This roof is of a flat hip-roof construction, with 3-ft. rise to the center. All wood used on this was painted with a wood preservative before using. The sprinkling filter covers 0.68 acre; with the present normal flow of about 1,500,000 gal. per day it will have a loading of abotu 2,200,000 gal. per day per acre.

Interesting Bridge Work in British Columbia

FINAL operations in connection with the construction of Taghum Bridge, a steel highway structure spanning the Kootenay River at a point about five miles distant from Nelson, B.C., were completed recently by the contractors, Messrs. Hodgson, King & McPhalen Bros., of Vancouver. The bridge was erected for the provincial government after designs by the engineers of the Public Works Department and cost approximately $100,000.

Leading from the north bank of the river, there are three truss spans of one hundred and seventy-four feet, resting on concrete abutments. These are succeeded by two short girder spans of fifty feet, supported on a concrete pier and abutments which form the approach of the south bank. The foundations have been placed in three piers of steel caissons sunk thirty feet below the river bed, the caissons being nine feet in diameter and lined inside with concrete. The width of the bridge roadway is twenty feet and the bridge itself is almost entirely a product of British Columbia, the steel used in its construction having been fabricated in Vancouver, the cement manufactured at Princeton, the lumber grown in this province, and the paint made at Victoria. The approximate amount of materials required included 150 tons of steel for the substructure, 220 tons of steel for the superstructure and 3,000 yards of concrete for the pier and abutments.

Constructional view of the Taghum Bridge over the Kootenay River, near Nelson, B.C.

Aggravating delays were encountered during the preliminary stages of construction on account of repeated failures to erect the false-work in the face of the tremendous current of the Kootenay River at this point. So much time was lost that the contractors were compelled to continually operate three shifts of eight hours each in order to complete the structure before the spring freshets set in. Despite these early reverses and the fact that work progressed for weeks at a time under most severe weather conditions, the bridge was completed in less than seven months from the date of commencing operations and well within the time limit. Construction proceeded from start to finish under the direct supervision of Mr. J. P. Hodgson, A. M. Inst. C. E., and Mr. W. A. McPhalen, members of the Vancouver firm which handled the contract.

Measurements that are difficult to understand should be avoided in planning forms for concrete work. All indications of dimensions should be simple and clear. Avoid wasting lumber, by making as few pieces as possible consistent with the required strength do the work. Avoid too much nailing, for this will make it difficult to knock down without splitting. Make forms strong enough to hold weight of concrete without bulging, for this causes leaks through which water, cement, and sand are lost and the concrete weakened, and also causes surface unevenness that disfigures the job. Besides, when forms lose their shape, it is difficult to use them afterwards. To save on cost of erection and removal, forms should be built in as large sections as are convenient to handle. The most economical wood forms, therefore, are those that strike a happy medium, combining the lightest weight with the largest surface compatible with required strength.

Constructing a filter plant by day labor was one of the features of the new sewage-disposal plant at Aberdeen, S.D. (12,000 population), described by W. G. Potter in a paper read before the Western Society of Engineers. The plant includes a sedimentation tank, sludge filter, siphon chambers, sprinkling filter and final settling basin. The total cost will be about $130,000. Labor was paid 22½c per hour at first, but for most of the work the rate was 25c per hour, and labor was very hard to get during the summer and fall seasons. Carpenters on form work were paid 35c to 45c per hour, and brick masons 70c to 80c per hour. The entire work except part of the excavation, part of the pipe hauling, and the construction of the pump-house superstructure, was done for the city commissioners by city forces, without contract, Mr. Potter being the designing and constructing engineer. He states that it is a good example of non-political municipal work, and that politics was one of the incidental troubles that was entirely absent from this work.

Regulations Governing Plans for Waterworks and Sewerage

THE Bureau of Public Health of the Saskatchewan Government have issued a set of regulations governing the preparation of plans for the installation and extension of waterworks, sewerage and sewage disposal systems. The regulations are the first of the kind issued by any province and the code should be found particularly valuable to municipal engineers. We extract below the instructions proper.

WATERWORKS SYSTEMS AND EXTENSIONS

Regulations

(1) **Engineer's Report—**

A report shall be submitted prepared by the engineer acting for the municipality giving information under the following heads, in so far as such are applicable to the proposed works.

1. Population—The present population and the rate of increase during each of the last five years; available data justifying a future increase of population and probable increase in next ten years.
2. Maximum population which system will provide for if fully developed.
3. Population provided for by proposed system.
4. Area and topography of municipality.
5. Estimated water consumption per capita per twenty-four hours.
6. Alternative sources of supply (if any) and if investigated.
7. Source of supply recommended.
8. Present available supply of water and how determined.
9. Estimated supply of water under full development.
10. Quality of water.
11. Any present sources of pollution of source of supply.
12. Measures recommended to prevent future pollution of source of supply.
13. Nature and construction of intake or collection works.
14. Wells—The number, depth, size and construction of wells; the nature of the ground through which they are sunk; the construction of collecting galleries.
15. Watercourses—Minimum dry weather flow, approximate watershed area. If continuous winter flow, reduction in available supply during winter.
16. Catchment areas—Approximate area of watershed, character of watershed surface with reference to probable run off, population, arable and stock farming and all available data having reference to rainfall.
17. Natural lakes—Approximate area of watershed, average depth of lake, area of lake, if overflow is continuous, approximate annual overflow, nature of watershed relative to population, arable and stock farming, and all available data having reference to rainfall. Population on shores winter and summer. If surface is used for traffic in winter.
18. The capacities and character of pumps; duplication of machinery and energy.
19. Sedimentation—The size and construction of basins.
20. Filtration—A full description of the proposed plant, including the type of filter, the nature of filtering media, the maximum rate of operation of each unit of the plant; the method of cleansing filtering media; the nature and amount of coagulent or disinfectant estimated to be necessary.
21. Provision for future extensions.
22. Provision for measuring and recording amount of water supplied to municipality.
23. Provision made for storage and capacity of reservoir, stand pipes, etc.
24. Size of force or gravity mains.
25. Distribution system, especially with reference to cut off valves, sluice valves, hydrants and through circulation; minimum size of pipes and minimum depth of trench; character of subsoil.
26. Pressure available for domestic and fire purposes.
27. Particulars as to any provision made for turning water other than the domestic supply into mains for fire protection purposes.
28. Provision to be made for inspection of construction.
29. Control and operation.

In the case of extensions to an existing system, the report shall, in addition to describing the nature of the proposed extensions, deal with as many of the above matters as are thereby affected.

(2) **Estimates of Cost—**

A statement prepared by the engineer shall be submitted showing the estimated cost of the proposed system or extensions. The estimated cost of all pipe lines shall be shown in schedule form as follows:

Location	Between	Size of pipe	Character of pipe whether steel cast iron etc	No of existing buildings requiring water	Average depth of trench	Length in feet	Cost of pipe laid complete per lin foot	Total cost

The estimated cost of all other sections of the work (e.g., land, intake, headworks, pumps, reservoir, hydrants, valves, etc.) shall be shown separately at the end of the schedule. The estimated operating costs per annum shall also be given.

(3) **General Plans—**

The following plans shall be submitted:

(a) **Plan of Municipality.**

A general plan of the entire municipality to a scale of not greater than 200 and not less than 500 feet to an inch. This plan shall show:

1. The municipal boundary.
2. All streets existing or proposed.
3. The approximate location of all habitable buildings not served with water at the date of application.
4. The surface elevations at all existing or proposed street insersections.
5. The elevation of the highest point in the municipality.
6. The location and size of all existing and proposed water mains.
7. The location of stand pipes, valves, hydrants and all appurtenances.

(b) **Location Plan.**

A plan to a suitable scale showing the site of the municipality, any outside territory affected, and the following:

1. The source of supply, intakes, wells, filters, pumps, reservoir and any special features.
2. The route of gravity or force mains.
3. The following elevations shall be shown:

(a) The low, mean and high water levels of the watercourse or lake at the intake.

(b) The highest known flood elevation of the watercourse or lake.

(c) Surface and water elevations at standpipes, reservoirs and principal points in the system.

(d) Surface elevations showing any irregularities of route with reference to the hydraulic gradient.

This plan is not required in the case of extensions to a distribution system.

(4) Analysis of proposed Source of Supply—

A sample of the water from the proposed source of supply shall be taken not more than six weeks previous to the date on which application is made to the Commissioner of Public Health for his certificate of approval. The sample shall be subjected to chemical analysis and bacteriological examination. A copy of the result of such analysis shall be submitted to the Commissioner of Public Health. The commissioner may require any number of samples extending over a stated period of time, if necessary.

The above shall also apply to each application for approval of extensions to an existing system, the sample being taken from the existing mains, should there be no proposed change in the source of supply.

(5) Affidavit Covering Section (4)—

An affidavit shall accompany any report of water analysis stating that the report of analysis and examination submitted is a true copy of the report supplied by the analyst, and that the water analyzed and examined was taken from the proposed source of supply. The date on which any sample was taken shall also be stated in the affidavit.

(6) Detail Drawings—

Detail drawings shall be submitted to a scale which shall clearly indicate the design of all sections of the proposed system or extensions, including all wells, collecting galleries, intakes, filters, settling basins, reservoirs, conduits, standpipes, siphons, blowoffs, pumps, machinery buildings and other appurtenances.

Profile—In the case of a gravity supply, a profile of the route of the pipe line shall be submitted, showing surface elevations, the hydraulic gradient of pipe line, and air and sluice valves.

(7) Specifications—

Specifications shall be submitted covering all work to be undertaken in the proposed system or extensions.

(8) Affidavits Covering Sections (6) and (7)—

All drawings and specifications submitted under sections (6) and (7) shall be accompanied by affidavits stating that the drawings and specifications so submitted are those to be used and followed in the construction of the proposed system or extensions.

SANITARY SEWERAGE SYSTEMS AND EXTENSIONS

Regulations

(1) Engineer's Report—

A report shall be submitted, prepared by the engineer acting for the municipality, giving information under the following heads, in so far as such are applicable to the proposed works.

1. Population—The present population and the rate of increase during each of the past five years. Available data justifying a future increase of population and probable increase in next ten years.
2. Maximum population which system will provide for if fully developed.
3. Population provided for by proposed works.
4. Area and topography of municipality.
5. Water consumption in municipality per capita per 24 hours.
6. The character of the sewage (with reference to surface and roof water, trade wastes, etc.)
7. Estimated maximum rate of flow expressed in gallons per hour.
8. Estimated normal dry weather flow expressed in gallons per 24 hours.
9. The general nature of subsoil throughout the municipality.
10. Precautions to prevent infiltration in water-bearing strata.
11. The minimum grades of all sizes of sewers.
12. Provision made for flushing and the intervals of flushing.
13. Character of pipes and joints to be used.
14. Type of sewage lifts to be adopted.
15. The maximum distance between manholes.
16. Ventilation of system.
17. Storm overflow discharges and any points of discharge other than the sewage disposal plant.
18. The areas of the municipality which cannot drain by gravity into proposed system. The proposed method of providing drainage for such areas in the future.
19. Provision to be made for inspection of construction.
20. Control and operation.

In the case of extensions to an existing system, the report shall, in addition to describing the nature of the proposed extensions, deal with as many of the above matters as are thereby affected.

(2) Estimates of Cost—

A statement, prepared by the engineer, shall be submitted showing the estimated cost of the proposed system or extensions. The estimated cost of all pipe lines shall be shown in schedule form as follows:

Location	Between	Size of pipe	Character of pipe whether fire-clay, concrete, etc.	No. of existing buildings requiring drainage	Average depth of trench	Grade %	Length in feet	Cost of pipe laid complete per lin. ft.	Total cost

The estimated cost of all other sections of the work (e.g., manholes, inspection chambers, sewage lifts, etc.) shall also be given.

(3) General Plans—

The following plans shall be submitted:

(a) **Plan of Municipality.**

A general plan of the entire municipality to a scale of not greater than 200 and not less than 500 feet to an inch, this plan shall show:

1. Municipal boundary.
2. All streets existing or proposed.
3. The approximate location of all habitable buildings not connected with sewers at the date of application.
4. The surface elevations of all existing or proposed street intersections.
5. The location, size and direction of flow of all existing and proposed sewers.
6. The location of all existing and proposed manholes, lampholes, flush tanks, sewage lifts, sewer outlets, overflows and other appurtenances.
7. Any areas from which it is proposed to pump the sewage; these should be indicated by light coloring or shading.

(b) **Contour Plan.**

A contour plan of the municipality to a suitable scale.

(4) Detail Drawings—

Detail drawings shall be submitted to a scale which shall clearly indicate the design of all parts of the proposed system or extensions, including all manholes, lampholes, flush tanks, siphons, pump wells, inspection chambers, buildings, iron work, machinery and other appurtenances. Transverse sections of all sewers over 24 inches in diameter shall be submitted.

Profiles—

Profiles of all sanitary sewers shall be submitted. The following scales are suggested for general adoption:

Vertical 10 feet to an inch
or 20 feet to an inch
Horizontal 80 feet to an inch
or 100 feet to an inch
or 200 feet to an inch

Profiles shall show all manholes, lampholes, flushtanks, siphons, river and railway crossings, the size and grade of sewers, the elevation of sewer invert and ground surface at all manholes and changes of grade; elevation of river or stream beds crossing the line of sewers.

(5) Specifications—

Specifications shall be submitted covering all work to be undertaken in the proposed system or extensions.

(6) Affidavits Covering Sections (4) and (5)—

All drawings and specifications submitted under sections (4) and (5) shall be accompanied by affidavits stating that the drawings and specifications so submitted are those to be used and followed in the construction of the proposed system or extensions.

STORM SEWERAGE SYSTEMS AND EXTENSIONS

Regulations

(1) Engineer's Report—

A report shall be submitted, prepared by the engineer acting for the municipality, giving information under the following heads, in so far as such are applicable to the proposed works.

1. Precipitation—All available data having reference to the maximum precipitation in the municipality, particularly with reference to short periods of heavy precipitation.
2. Nature of ground surface—The areas paved and unpaved, and in the case of the latter, the degree of porosity of the ground.
3. The area and mean slope of each district draining to a trunk sewer or point of discharge.
4. The data and assumptions upon which the computation of the size of sewers is based.
5. The estimated maximum volume of flow (in cubic feet per second) at each point of discharge, and the estimated increase when the system is fully developed.
6. The character of pipes and points to be used.
7. The nature of coating (if any) to be used on the outside of pipes.
8. Any connections which it is proposed to make with the sewers, other than for surface water.
9. Provision to be made for inspection of construction.
10. Control and operation.

In the case of extensions to an existing system, the report shall, in addition to describing the nature of the proposed extensions, deal with as many of the above matters as are thereby affected.

(2) Estimates of Cost—

A statement, prepared by the engineer, shall be submitted showing the estimated cost of the proposed system or extensions. The estimated cost of all pipe lines shall be shown in schedule form as follows:

Location	Between	Size of pipe	Character of pipe whether fireclay, concrete, etc	Average depth of trench	Grade %	Length in feet	Cost of pipe laid complete per lin. ft.	Total cost

The estimated cost of all other sections of the work (e.g., manholes, catch basins, etc.) shall be shown separately at the end of the schedule. The estimated cost of operation per annum shall also be given.

(3) General Plans—

A general plan of the entire municipality shall be submitted to a scale of not greater than 200 and not less than 500 feet to an inch; this plan shall show:

1. Municipal boundary.
2. All streets existing or proposed.
3. The surface elevations of all existing and proposed street intersections.
4. The location, size and direction of flow of all existing and proposed storm sewers.
5. The location of all existing and proposed manholes, catch basins and connections to the storm sewerage system, also all points of discharge and natural watercourses.
6. The extent of street paving.
7. The areas draining to each trunk sewer or point of discharge (these may be shown by distinctive coloring or shading).

(4) Detail Drawings—

Detail drawings shall be submitted to a scale which shall clearly indicate the design of all parts of the proposed system or extensions, including all manholes, catch basins, valves, etc. Transverse sections of all sewers over twenty-four inches in diameter shall be submitted.

(5) Specifications—

Specifications shall be submitted covering all work to be undertaken in the proposed system or extensions.

(6) Affidavits covering Sections (3), (4) and (5)—

All plans, drawings and specifications submitted under sections (3), (4) and (5) shall be accompanied by affidavits stating that the plans, drawings and specifications so submitted are those to be used and followed in the construction of the proposed system or extensions.

SEWAGE DISPOSAL WORKS AND EXTENSIONS

Regulations

(1) Engineer's Report—

A report shall be submitted, prepared by the engineer acting for the municipality, giving information under the following heads, in so far as such are applicable to the proposed works:

1. Population—The present population and the rate of increase during each of the past five years. Available data justifying an increase of population and probable increase in next ten years.
2. Maximum population which system will provide for if fully developed.
3. Population provided for by proposed works.
4. Water consumption in municipality per capita per 24 hours.
5. Estimated maximum rate of flow of sewage arriving at works, expressed in gallons per hour,

6. Estimated daily flow of sewage arriving at works.
7. The number of connections already made to sanitary sewerage system.
8. The character of the sewage (with reference to surface and roof water, trade wastes, etc.) Any excess over domestic sewage shall be estimated in gallons per hour under:
   (a) Roof water;
   (b) Surface water;
   (c) Infiltration water;
   (d) Trade waste water.

In the case of trade discharge the character of the waste shall be given.

9. The distance and location in relation to the works of any wells or underground source of water supply. In the case of the final effluent discharging into a watercourse or lake, it shall be stated whether such watercourse or lake is, or eventually becomes, a source of domestic supply or is used for watering cattle.
10. Minimum volume and velocity of stream or river into which the final effluent will be discharged.
11. Area of land acquired for sewage disposal purposes.
12. Character of subsoil through which sewerage system is laid, with particular reference to the presence of sand.
13. Character of treatment processes to be adopted.
14. Type of sewage lifts to be used at sewage disposal works.
15. Provision for dealing with sewage in the case of failure of sewage lifts.
16. Type of screens and provision for the removal of screenings.
17. Preliminary precipitation of mineral particles—velocity of flow in detritus tanks.
18. Type of sedimentation tanks, capacity and velocity of flow in tanks, inclination of base of tanks.
19. Method of drying sludge and final disposal.
20. Capacity of dosing or siphon chamber.
21. Type of filter beds; character, area and depth of filter media. Rate of filtration. Method of distribution over surface of media.
22. Retention of humus.
23. Disinfection of effluent.
24. Provision against frost.
25. Location of bypasses.
26. Provision for measuring and recording flow of sewage.
27. Future extensions.
28. Provision for grading, surfacing, etc.
29. Control and operation.

In the case of extensions to existing works, the report shall, in addition to describing the nature of the proposed extensions, deal with as many of the above matters as are thereby affected.

(2) Estimates of Cost—

A statement prepared by the engineer shall be submitted showing the estimated cost of the proposed works or extensions. The estimated cost of each section of the work (e.g., land, pipe lines, sedimentation tanks, filter beds, mechanical appliances, buildings, etc.) shall be shown separately. The estimated cost of operation per annum shall also be given.

(3) General Plans—

The following plans shall be submitted:

(a) **Location Plan.**

A location plan to a suitable scale showing:

1. The location of the works in relation to the site of municipality.
2. The route of the main outfall sewer.
3. The layout of the various units of the sewage disposal works, including all drains, pipe lines, etc.
4. The area of land to be utilized for sewage disposal purposes.
5. The lake, watercourse or subsoil, into which the final effluent will be discharged.
6. Elevation of high, mean and low water in watercourse or lake.
7. Highest known flood elevation of watercourse.
8. Elevation of effluent drain at point of discharge and of outfall sewer at entrance to works.

(b) **Sketch Plans.**

Preliminary sketch plans shall be submitted to a scale which shall indicate the type and capacity of the various tanks, filter beds, etc.

The principal elevations and measurements of the various parts of the works shall be indicated on these plans. Such preliminary plans shall give sufficient information to enable the commissioner to arrive at a conclusion as to the efficiency of the proposed processes of treatment and design, and structural details may be omitted therefrom. Sketch plans need not be submitted if the detailed drawings required by section (4) accompany the application.

(4) Detail Drawings—

Detail drawings shall be submitted to a scale which shall clearly indicate the design of all parts of the proposed works. Longitudinal and transverse sections of all tanks and filters shall be shown.

Profiles—

Profiles of all pipe lines and drains shall be submitted drawn to a suitable scale.

(5) Specifications—

Specifications shall be submitted covering all work to be undertaken in the proposed system or extensions.

(6) Affidavits Covering Sections (4) and (5)—

All drawings and specifications submitted under sections (4) and (5) shall be accompanied by affidavits stating that the drawings and specifications so submitted are those to be used and followed in the construction of the proposed works or extensions.

It was announced recently that the Pulsynetic System of Electric Clocks (Messrs. Gent & Company, Limited, Faraday Works, Leicester, Eng.), was to be installed on the "Aquitania" and we are now informed that the behaviour of these clocks on the maiden voyage of the great liner was more than satisfactory. Messrs. Gent & Company report gratifying activity in their electric clock department. Of many important installations now in hand mention may be made of the Allan Line offices at Montreal, the Dominion Bank, Toronto, and the premises of Messrs. Henry Birks & Son, Vancouver. In the Dominion Bank equipment there will be fifty dials, some of these being in marble cases. Orders have been received from South Africa, Australia, Russia, and from many parts of the United Kingdom.

At the annual meeting of the Society for the Promotion of Engineering Education held at Princeton University, the following officers were elected for the ensuing year: President, Anson Marston, Dean of the Division of Engineering, Iowa State College, Ames, Iowa; Vice-Presidents, Henry H. Norris, New York, and C. Russ Richards, Acting Dean of the College of Engineering, University of Illinois, Urbana, Ill.; Secretary, F. L. Bishop, Dean of the School of Engineering, University of Pittsburgh, Pittsburgh, Penn.; Treasurer, William O. Wiley, John Wiley & Sons, New York; members of the council, R. H. Fernald, A. H. Fuller, A. M. Greene, Jr., E. V. Huntington, Vladimir Karapetoff, D. C. Miller, W. M. Riggs. The reports of the various officers showed that the society is in a flourishing condition. The individual membership is now nearly 1,400 and the institutional membership about 50. The council recommended that the 1915 meeting be held in the Middle West.

The Fundamental Principles of Aesthetic Bridge Design

As our bridges are becoming more permanent in character, and as their minor features are becoming standardized, engineers can well afford to give increased attention to the aesthetic design of such structures, says a writer in Engineering and Contracting. The engineer should not consider his problem solved when he has provided a structure which will economically carry the required loads; he should not authorize its construction until he has carefully studied the structure with a view of improving its appearance. In many cases the increased cost of an aesthetic design is relatively very small. The following article, which was abstracted from a paper by Charles Evan Fowler, in Proceedings, Pacific Northwest Society of Engineers, considers some basic principles applicable to the aesthetic design of bridges.

The designing of a bridge is not merely a matter of figuring the stresses, fixing the sizes of members, and making a set of drawings. This may all be completed and a design may result, but the design may be one which is not suitable for the location and is not such as it should be architecturally.

The true design to adopt must come very largely as an inspiration to the designer, who must have the necessary talent or imagination to conceive a bridge that will be the most appropriate and harmonious for a given location, and for the existing or future surroundings.

Discussion of Some Important Bridges

The Tower Bridge in London, considered by many writers to be a monstrosity, was conceived by the engineer Sir John Wolf-Barry to harmonize with the surroundings, and particularly with the old Tower of London in the immediate vicinity. When considered in this light it is an appropriate and harmonious design; the mediaeval towers are monumental and the steelwork graceful.

The great suspension bridges of New York are of the same class and are mostly in harmony with the towering buildings in the adjacent territory. The details, however, have not always been carried out in the proper spirit, the towers of the Roebling Bridge, never having been completed, and are thus lacking as truly monumental or architectural features. The towers of the nearby Manhattan Bridge are too light to harmonize with those of the Roebling Bridge or with the nearby buildings, although considered alone it is a complete and pleasing design. The Williamsburg Bridge is entirely lacking in architectural features, it is out of harmony with the present or probable future surroundings, and is only notable in design by reason of its magnitude and the graceful sweep of its cables.

The great arch at Hell Gate, over East River in New York, is, with its 1,000-ft. span and carefully designed abutment towers, a truly monumental structure, and the abutment towers are well designed and appropriate, the great arch demanding this mass for backing to satisfy the impression of a great thrust properly cared for or resisted.

The Washington Bridge across the Harlem, one of the great bridges of the world, is wonderful in its architectural detail, but is lacking in the great essentials for a work of architecture. The main structure consists of two spans, instead of three, thus giving a pier in the middle; and the approaches are not balanced, thus causing the structure to lack in symmetry. Some of the other designs for this structure, while simple in detail, would have made a much better structure and a more pleasing one, as they possessed the fundamental features that are necessary to any real work of architecture—simplicity, symmetry, harmony and proportion.

This is well illustrated by the Eads Bridge, at St. Louis, with its three great arch spans and appropriate approaches. Although the details of the structure are very simple, it is one of the most pleasing and dignified of the world's bridges.

Governing Considerations

The conception of a design depends upon no rules, but upon the inherent ability of the designer, limited as we shall see hereafter by certain theoretical and practical requirements. There may be conceived a number of designs for a given location of different types, any one of which would be appropriate and beautiful, but the final decision as to which one of these to adopt must be made on the basis of relative cost, the most economical being usually selected. On the other hand the most economical should not always be selected, but the best design architecturally should be adopted, especially where the difference in cost is not very large.

The cost, for example, of a four-span structure for a given crossing might be found to be somewhat less than for a three-span bridge, yet it would be wise from any architectural standpoint to adopt the three-span design. The four-span design would have to be very much cheaper than three spans to call for its adoption. The reason for adopting a three-span design in place of a two-span bridge might, on the other hand, be based entirely on the architectural features, as the cost and risk of the three-span structure might be much the greater.

There are, then, two considerations that govern in making a decision as to what design to adopt for any location—the architectural features and the economy of construction, which latter may well be discussed in full before considering the architecture of bridges, and entirely aside from the aesthetics of the problem.

The loads on the piers for various lengths of spans must first be determined in order that the foundations, abutments, and piers may be designed and the costs determined as factors in the cost of complete structures with different numbers of spans. The load on the pier and the weight of the pier having been determined, the size of the base of the pier may be arrived at by using the formula for the allowable pressure on the foundation bed, as given in the writer's treatise on "Sub-Aqueous Foundations," the character of the foundation bed having been determined previously by careful core borings. Several trials may be necessary before the proper size of a pier is determined, and then careful calculations as to the stability of the pier must be made. Should the size be found deficient, as is often the case with deep trusses, or where bascule or lift spans are employed, then it must be increased in length of base until the maximum allowable stresses and pressures are not exceeded. Then, by means of the cost abutments, piers and spans, the relative costs of various designs may be determined, the weight of the spans being calculated from reliable formulas or from actual stress and section diagrams. The whole process may be somewhat shortened by using the "Ottewell" formula given in the writer's treatise, or that given in "Merriman's" Vol. III. The design of the approaches may be a factor in the relative costs, and in such cases must be included in making the comparisons.

Type of Superstructure and Details of Design

The type and design of the superstructure are such a large factor in its cost that they must be fully decided upon before beginning any of the above investigations, and then all designs can be compared upon a common basis. Where the grade is high above the stream, with plenty of clearance for floods and navigation, deck spans of some type are of course the most economical to employ. Where the bridge is high or where the falsework is expensive for other reasons, it may be best and cheapest to use an arch or a cantilever design. Where very long spans are necessary either the cantilever or suspnesion bridge must be used. Where the clearance for high water or navigation is limited through trusses must be used, although it will often be best to use cantilever spans instead of simple trusses. Through arches or half-through arches may often be employed with good results, both architecturally and economically.

The economical design of the superstructure of a bridge requires careful consideration as to the style of trussing, panel length and truss depths. Longer panels and deeper trusses are more economical for modern heavy loads, but for plate and rivetted lattice girders the depths are usually much less than for regular trusses. The span lengths for cantilever bridges should always be decided by careful mathematical analysis, as well as the lengths of the cantilever arms, suspended spans and depths. The height of towers and the depth of stiffening trusses for suspension bridges must also be carefully analyzed.

The design of movable spans should be carefully considered, not only with regard to first cost, but as to cost of operation and maintenance as well; but one should not get the idea that revolving draw spans are out of date, for in many locations they are the cheapest and the best to employ. Then there are locations where bascule spans are the best from every point of view, but where used they should harmonize with the remainder of the structure if there are additional spans; but in many cases those forms must be abandoned that have no pretensions to architecture or beauty, and the same thing may be said with regard to other types of movable spans.

The details for ordinary spans have reached a practically permanent basis, so that standards, at least as to type, are usual. Where the structure is of unusual size like the Blackwells Island Bridge, the Forth Bridge, or the Hell Gate Arch, each member must be the subject of critical analysis and study. Lack of such study and analysis was the cause of the failure of the first Quebec Bridge. Great suspension bridges are of necessity special problems throughout and must be studied with greater care than any other type.

The floors of railway spans are usually of a standard type, either having steel stringers and ties or a steel trough floor with ties laid on the ballast; but the types of floor and paving for highway bridges are so numerous that it is often a grave quetsion what type to adopt. The cheapest floor that should in any case be used on a good bridge is one having steel joist with spiking strips bolted to them, to which the floor plank is spiked. The very best floor is undoubtedly a reinforced concrete slab, with from 1½ to 2 ins. of sheet asphalt surface, although it may be wise to use a creosoted block surface, the thin blocks being set directly in asphalt on the concrete and filled with sand or grouted.

Having discussed those things which have to do directly with the economy of bridges, with masonry piers and steel superstructures, we may well discuss structures built entirely of stone, of concrete, or of reinforced concrete. Such structures must be fully designed and a careful estimate of cost made in order to make any reliable comparisons. The cost of stone bridges is, of course, the greatest of any type which might be considered, and in the case of the Knoxville Bridge where the cost of the arched cantilever was only $250,000 the bids for the stone arch design were about $1,500,000, thus making it out of the question to use stone where low first cost was a necessity. The same is true to a very great degree with concrete arches, but when reinforced concrete arches are considered, they may be designed to cost but slightly more in many instances than steel bridges, and should be carefully considered where a permanent and artistic structure is demanded.

Basic Principles of Aesthetic Designing

There are, it is true, no orders of architecture for bridges as for buildings, nor is there possible any classification of styles for particular ages, as in the case of building architecture, but drastic rules must be observed, whether the design be for a building or for a bridge.

Simplicity, harmony, symmetry, and proportion must be regarded in any design that would have any pretensions to beauty or to architectural effect. They are the fundamentals of true architecture, no matter what the structure may be to which thought is to be applied in its design.

Simplicity means first a truth telling structure, no subterfuges about the lines of stress, no covering up of a concrete structure with a stone facing, no frivolous or inappropriate details, but a strict adherence to the necessary features, whether they are to carry the loads or to ornament the bridge.

Harmony is essential to a pleasing design, for without it the structure would be distasteful. Harmony not only as between substructure and superstructure, between the various spans, between the spans and the approaches, between the utilitarian features and the ornamental details, but also with the surroundings.

Symmetry may or may not be essential to a pleasing design, although it usually is necessary if a truly architectural structure is to result. Where the bridge has a great length, unsymmetrical features are not so noticeable as in a shorter one which may be all taken in at a glance. As is often true in a landscape, balance may frequently be secured by including unsymmetrical features. For example, in a bridge which contains a draw span or other unbalanced feature, some feature may well be introduced in another part which will tend to restore the balance, even though symmetry does not result.

Proportion is necessary in order that the three preceding principles may be realized; and usually when the economical proportions have been determined, they are pleasing. However, in many cases modifications must be made to reach the point where economy and beauty can both be satisfied. Proportion of details employed for ornamentation is quite another thing, and to be harmonious bridges must have the proper proportion.

Examples may be seen in every structure of the proper application of some of these principles, but more often we find one or the other flagrantly violated, so that the remark of C. Shaler Smith, that Dean of American bridge engineers, to one of his assistants should be well remembered by him who would reach high rank in his profession—"most bridges are examples of what not to do." Seldom if ever do we find a structure that complies with all of the fundamentals, although many bridges approach so nearly to the ideal that careful consideration and analysis is necessary to determine just where improvement could be effected.

Simplicity is best illustrated in its pleasantest features by suspension bridges and arches with no decorations or embellishments of any kind. Harmony is best exhibited where no part of the structure seems to be extraneous, and where the structure seems part of the surroundings. Symmetry in its simplest form is where one-half of the structure is exactly like the other. Proportion is most nearly reached when the structure is most pleasing and the truth expressed most accurately.

The basis for a real architectural system for bridges must come of course from building architecture, and on studying the columned or arched facades of buildings we find an uneven number of openings or arches are employed in the great majority of the world's notable and best pieces of architecture. Where there is an entrance it is nearly always in the centre, with one or more arches symmetrically disposed on each side.

Careful study and analysis of the examples of Egyptian, Roman and mediaeval buildings discloses the fact that such an arrangement is most pleasing to the senses, and where it has been violated the design is unpleasant. This, then, we may take as the starting point of any design, an opening instead of a pier at the centre, with the remainder of the structure arranged symmetrically on each side. Carried to its logical conclusion, where there is an approach it should have an uneven number of openings, and where there are spandrel arches employed in an arch bridge, they should be of an uneven number.

Discussion of Some Existing Bridges

The Knoxville arched cantilever, designed by the writer, was of five main spans and two anchor arms, thus giving an opening at the centre and a perfectly symmetrical structure, except that one abutment was longer than the other, but this is not apparent to the eye in a structure a third of a mile long. Economy was violated in the depth of the anchor spans in order to make the bridge harmonious and the basic rules were all as nearly adhered to as is often the case.

The Market street arch, at Youngstown, Ohio, designed by the writer, was a very difficult problem to solve, both on account of the side spans having to clear the railway tracks and on account of the 4 per cent grade of the roadway. The design, however, is symmetrical with the exception of the grade and the approaches, and it was made quite harmonious by carrying the sub-trussing of the side spans through at the same elevation as the lattice truss over the arch.

Comparing the Memphis Bridge, by Morrison, with the Thebes Bridge, by Modjeski, we can readily see how much is gained in architectural appearance by the symmetrical arrangement of the spans in the Thebes Bridge. Comparing the approaches of the Thebes Bridge with the approaches of the Forth Bridge, we see how much more in harmony with the main structure are the approaches of the Forth Bridge than those of the Thebes Bridge, although considered alone the latter are of the best design architecturally.

The Grosvenor Dee Bridge, at Derby, England, with its 200-ft. masonry span, is one of the great bridges of the world, but the panelling of the abutments and spandrels, and indeed all the decorations, are so out of harmony with the great span that they dwarf it and ruin the design. Compared with similar details of the Eden Park reinforced concrete arch, Cincinnati, Ohio, we find such ornamentation entirely appropriate and harmonious for the smaller span.

European bridges are more often well designed architecturally than those of other countries and the great bridge over the Rhine, at Bonn, Germany, is an example where simplicity, harmony, symmetry and proportion are all as fully met and satisfied as has ever been the case in any bridge structure.

The Camelback Bridge in the Imperial Palace grounds at Pekin, China, is also one of the most perfect of the world's bridges from the architectural point of view and satisfies the cardinal requirements of design.

The best design in the United States, in the writer's opinion, is the Connecticut Avenue Bridge, in Washington, D.C., with its five great concrete arches. Very little fault can be found with the design, except the inappropriate decoration of the wing walls of the abutments. The designing of harmonious and appropriate details in the proper proportion is a study in itself and is entirely beyond the scope of this paper. However, should designers carefully observe the cardinal principles herein laid down much more pleasing structures would result and a great stride forward be made in bridge engineering and architecture.

The necessity for good construction, especially of foundations, must not be overlooked, and no matter how chaste and beautiful the design, it is as nothing if not of first-class engineering and construction.

A rope railway, seventy-five miles in length, is to be put in operation in India. It will connect the rich country in the Vale of Kashmir with the plains of the Punjab over the Himalayas. The line, it is claimed will be the longest in the world, the present longest being 22 miles and situated in Argentina. Sections will be 5 miles long, and most of the spans will be 2,400 ft. The steel towers, some of which will be 100 ft. high will be braced, and double 1½-in. cables, 9 ft. apart, will carry the steel cars. The carrying capacity of these cars will be about 400 lb.

A contemporary points out that in fire after fire it has been demonstrated that unprotected ironwork only helps to destroy buildings "by expanding and pushing out the walls or yielding under the heat and pulling them down." After referring to slow and costly experience of so-called methods of fire-proofing, our contemporary makes the following remarks upon reinforced concrete:—"Whatever may be the opinion of architects as to its adaptability, there is no doubt that its proved fire-resisting and other desirable qualities ought to secure its use for the structural portion of all large buildings. We are afraid, however, that safety alone is not a sufficient inducement to adopt it, and not until architects and capitalists find that it is really an economical method of construction and makes a good foundation for adornment shall we see it as widely used as we think it should be."

Disinfection of Sewage and Its Success in a Small City

By Frank A. Nikirk, Consulting Engineer, San Jose, Cal.

THE College Park sanitary district which lies adjacent to the City of San Jose, Cal., was organized in 1905. The boundaries of the district were extended in 1907 to include Hanchett Park, an exclusive residential district, and now include an area of about 2.6 square miles. At present the population of the district is slightly over 2,000.

As originally constructed, the sewage disposal works consisted of a septic tank and two filter beds. The plant is located on the bank of the Guadalupe Creek, into which the effluent of the filters was conducted. The filters were built in a natural excavation; about two feet of creek gravel was placed in this. The filters were approximately 340 feet long; one was 12 and the other was 15 feet wide.

The beds were not underdrained; for this reason and also the lack of depth of the filtering material, they were never very satisfactory. They were early abandoned and the effluent of the septic tank was discharged directly into the creek.

When water was plentiful in the Guadalupe Creek this effluent was not a nuisance. For the past two years, however, there have been no freshets to cleanse the channel, the growth of vegetation has been very rank and the amount of water flowing in the creek has been far below normal.

Under these conditions, with the water in the Guadalupe containing a relatively low percentage of dissolved oxygen, it can be readily seen that conditions are not very favorable for the disposal of sewage by dilution. The growth of vegetation checks the tendency toward re-aeration, and an unsanitary condition is apt to exist.

Under such circumstances it became necessary to treat the effluent of the septic tank before discharging it into the creek, therefore a temporary plant for treatment with chloride of lime was installed while the present plant was being constructed.

A treatment plant of this type requires a supply of water with which to mix the chloride of lime; consequently a windmill and tank were constructed over a well that existed at the end of the septic tank. The hypochlorite apparatus was located in the tank frame, which was inclosed to protect the plant from outside interference, as a constant and uniform action is required.

The apparatus consists of a mixing tank and two storage tanks, each holding about 275 gallons, and a fourth tank, in which are located the devices for regulating the flow. The tanks are arranged so that the flow is by gravity throughout the entire plant. Each tank is provided with an outlet through which to draw the solids that settle out of the solution.

The chloride of lime is put into the mixing tank and the tank filled with water. During the filling the solution is thoroughly mixed. The stirring device consists of a sort of propeller on a shaft, suspended from the top of the mixing tank. The shaft is revolved by a ratchet device operated by moving a lever backward and forward.

After mixing, the solution is allowed to stand sufficiently long to let the greater portion of the suspended matter settle. The clear liquid is then drawn off into the storage tanks through an outlet six inches above the bottom, so as not to disturb the settled solids. More water is then turned into the mixing tank and the insoluble residue is stirred up and flushed into the outlet sewer. The operation is then repeated.

At the College Park plant three "batches" are mixed each morning for a twenty-four hour run. The third "batch" is drawn slowly from the mixing tank and into the storage tanks as the latter are being emptied. This method was adopted in order to use the maximum quantity of water, the greater flow being more easily regulated.

In small installations, irregular flow of the solution is common, due to the clogging of the measuring orifice by imperfectly settled solutions, or by flakes of calcium carbonate being formed in the solution tank by the absorption of carbon dioxide from the air.

In this particular installation the solution flows from the storage tanks to the regulation tank and is controlled by a float valve which keeps the liquid in the latter at a constant height. In the regulation tank is a half-inch brass tube extending from above the surface of the liquid down through a large rubber stopper in the bottom of the tank. In the side of the tube is a three-sixteenth-inch hole which admits the solution. The rate of flow depends upon the head of water upon the orifice, and the desired rate may be obtained by raising or lowering the tube through the rubber stopper in the bottom of the tank.

From this tank the solution is carried through a four-inch vitrified pipe line to the outfall sewer, where it mixes with the effluent of the septic tank.

The sterilizing action of chloride of lime is very ably set forth by Professor Charles Gilman Hyde in a paper presented before the fourteenth annual convention of the League of California Municipalities at Santa Barbara in 1911 and entitled, "The Sterilization of Water Supplies by the Use of Hypochlorites." While Professor Hyde's paper refers particularly to the protection of water supplies, the action of hypochlorites is analogous in the purification of water supplies and sewage effluents. In both cases hypochlorous acid is formed, which gives up its oxygen in the presence of organic matter.

In designing disinfecting apparatus one of the important factors to be dealt with is the fact that calcium hypochlorite exerts a very strong corrosive action upon wood and most metals. In some cases the tanks are lined with cement mortar laid on metal lath; in others a resistant paint is used. The pipes should be well galvanized and the valves should be bronze. The plant should be well ventilated, as the dust arising when the drums of chloride are opened, and during the making of the solution, is very irritating to the eyes and the membranes of the head.

Hanging walls of Imhoff tanks in a small installation near Chicago were constructed in sections on the flat, outside of the tank and the wire reinforcement left sticking out of the ends to secure it when placed in proper position, according to L. K. Sherman in discussing a recent paper before the Western Society of Engineers by W. G. Potter on the "Sewage Disposal Plant at Aberdeen, S.D."

Sewage Disposal for the Country Home

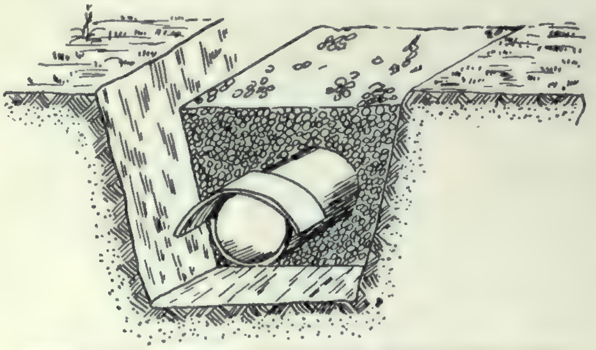
How to Build of Brick and Vitrified Sewer Pipe a Simple and Most Efficient Plant

By Benjamin Brooks

IN some respects the cities are healthier than the country. I read Thoreau and other nature literature, and like it; but all the same it is upon going to the country for a vacation, not upon returning to the city, that I submit to having myself punctured by Dr. Watson's needle full of typhoid preventive.

The reason the cities are ahead of the farmers on sanitation is because they have had to be. Problems of sewage disposal overcome by cities generations ago, are now confronting the farmer for the first time. Sewage disposal on the farm was formerly carried on largely through the back kitchen window.

Five years ago a city firm was greatly astonished to receive an order from a remote but prosperous farmer for a first-class porcelain bathtub and "fittings." The firm wrote back, asking him if he didn't mean an enamelled tub, advising him of the high cost of the porcelain article. The farmer answered immediately to the effect that he knew what the proper stuff for a bathtub was, that he had the money to pay for it; also, that he was as good as any city dweller and was going to have what he wanted.


Method of surrounding the vitrified sewer pipe with broken stones.

A great many farmers have since come to the same conclusion. Their wives have read the hot-and-cold water advertisements in various magazines and their daughters have just returned from college.

The inevitable result is a gasoline-driven pump at the well instead of a bucket on a rope, a complete piping system upstairs and down instead of a barrel on the back porch, and a fully equipped bathroom that uses up more than a hundred gallons of water per day for each member of the household.

But now comes the farmer's real problem—how to get rid of the hundred gallons per. In summer the old sump hole down in the corner of the lot is overflowing to the vegetable garden and the duck pond. The flies are "just awful," the atmosphere is also "just awful." Typhoid threatens. The farmer must have a sewage disposal plant.

Sewage always contains a multitude of bacteria. Certain kinds of these decompose garbage into its original elements. But these little workers to operate to advantage must have certain conditions. These conditions are to be found in sewage disposal plants, which are constructed in such a way as to meet this need. Among the farmers they are becoming more common. A sewage disposal plant, then, is nothing but a "bug farm;" but it must be remembered that the "bugs" are exceedingly fussy. Some must live in water without air. They prefer quiet neighborhoods and resent disturbances. You see now why the old-fashioned sump is not a suitable bacteria farm.

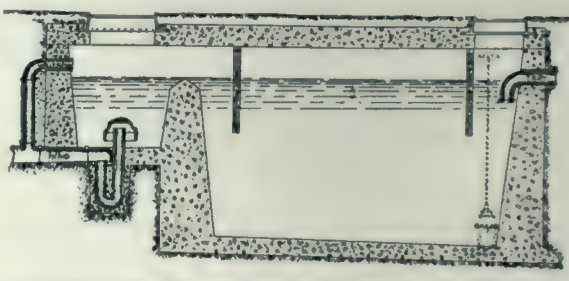
The first stage of a farm sewage disposal plant is a settling tank sunk in the earth. For a family of four, it should be about five feet deep, four feet long, and three feet wide. The inlet pipe from the house should enter it at a grade of about three inches to a hundred feet and turn down under water to prevent splashing. A baffle board in front of it will also prevent disturbance in the tank; and the industrious bacteria, although experiencing much inconvenience due to changes of environment and sudden inrushes, will manage to dissolve and disintegrate a part of the putrescible matter. Meanwhile the stray dish rags, hair pins, or other obstructions will tend to sink quietly to the bottom.

The sewage then passes under another baffle, over the end wall at the far end of the settling tank, and so into a discharge chamber with a siphon at the bottom. The sewage having risen to the proper level, the siphon—just a plain flush tank siphon always to be had in the market—automatically empties the discharge chamber.

The ideal home for aerobic bacteria or "fresh air bugs" is a pile of loose stones flooded from time to time with rich and delectable sewage. We have, therefore, but to lay a line of three-inch vitrified clay sewer pipe in an open trench leading away from the settling tank and then fill the trench around it with broken stone about the size of a pigeon's egg.

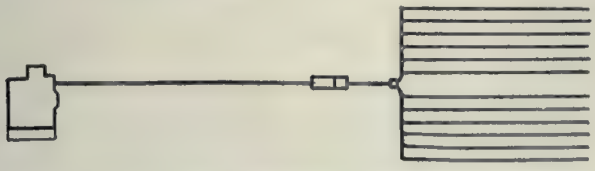
In order to allow for possible repairs, lay two lines of vitrified clay sewer pipe in two rock trenches each about one hundred feet long. The pipe is not porous, of course, for then the winter frosts would burst it, and plenty of room must be left at the joints for sewage to leak out into the rock trench.

All the materials for a sewage disposal plant, in fact, must be of the best on account of the strong chemical nature of sewage. Tanks should be built of excellent brick set in rich cement so "slushy" that the joints cannot be entered by the point of a trowel. The brick themselves are acid proof. Where concrete has to be used, it must be of the best, with a carefully trowelled surface, for such concrete as is ordinarily used for water culverts or sidewalks is soon destroyed by sewer gas. Metals should be used sparingly for they are all sure to corrode rapidly.


Cross section of small settling tank with intermittent discharge siphon.

Having thus been provided with model housekeeping apartments, the aerobic family are quick to move in. During the flooding of their dwellings they may be figuratively, said to stock their pantries and to eat greedily.

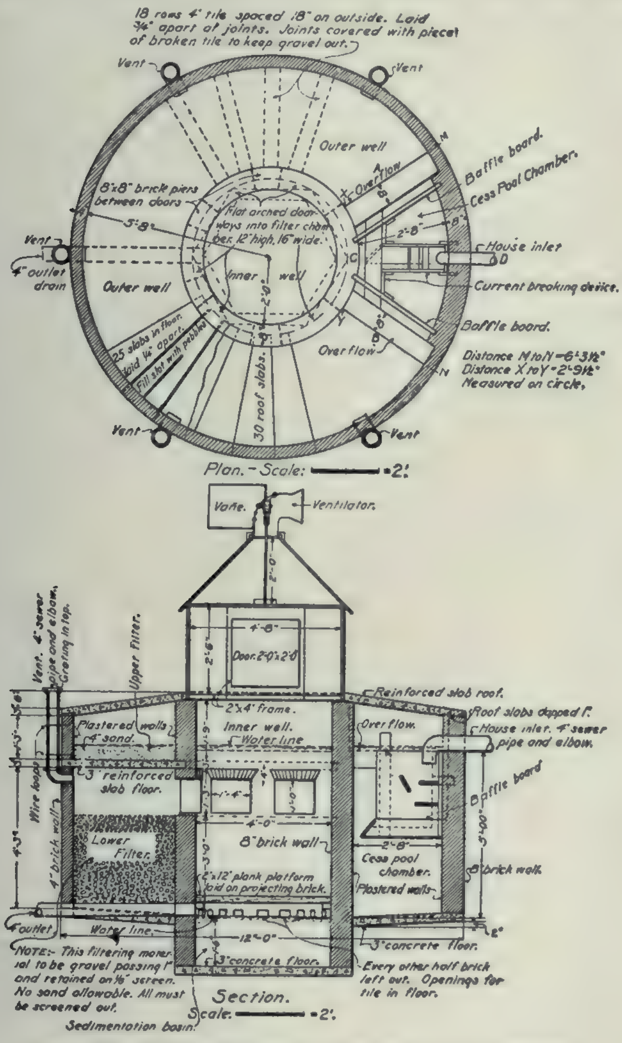
Now, of course, there are many modifications of this simple lay-out. The tank, for instance, can have a sort of double bottom with a slot in the upper one to let down the settling solids, and a sluice gate in the lower one to sluice out the sediment every few months.



Ground plan showing relative position of house with settling tank of brick and distributing tiling.

If the ground slopes sufficiently and the amount of sewage permits, liquid can be sprayed continuously over the rock trenches instead of flooding them intermittently—in which case there is no need of the flush-tank siphon in the settling tank.

Again, if the soil is very porous and sandy, we do not need broken stone, but may simply bury the clay pipe in the soil. The finer the gravel, the purer the water coming from the disposal plant, but the more liable is the kitchen grease to clog up the whole system.



Ground plan and vertical section of circular tank 16 ft. in diameter.

Since no settling tank is perfect and no siphon is absolutely proof against clogging, and no stone trench entirely proof against freezing, there has been evolved a very compact and efficient disposal plant all in a nutshell, with neither siphons, valves nor exposed beds. It gives great promise of success.

This plant, shown in the illustrations, consists of a circular tank sixteen feet in diameter, sunk in the ground, with another smaller circular tank inside it. The large outside tank is a shallow two-storey affair, while the inside one is a deep well. Sewage flows into a settling pocket on one side, and having overflowed this, streams out over the second story, making a shallow lake for the pleasure of the anaerobic or sea-going bugs. It then strains through a bed of coarse sand, drips through holes in the floor, and rains down on the fresh air cranks that live in the broken stone down stairs. Having been shorn of all its objectionable features by these voracious ones, it trickles down to the bottom of the central well and then flows harmlessly away. Ventilators, meanwhile, cause fresh air to stream through the tank.

From all this it appears that a sewage disposal plant on the farm is a matter of careful planning and attention to certain necessary details but simple in construction, cheap in cost and can be built by any farmer who wants to do it.

Fire-Retardent Paint for Shingles

ONE of the many interesting papers read at the annual convention of the Master Painters and Decorators' Association of Pennsylvania held recently in Pittsburgh, was that on the above subject by Henry A. Gardner of the Institute of Industrial Research, Washington, D.C. The paper was of considerable length and dealt with many phases of the subject, including a description of a series of laboratory tests to determine the heat deflecting properties of various types of roofing materials. Miniature houses were roofed with bare shingles, painted shingles, tin and stone. These houses were placed in an oven heated to 150 degrees Centigrade. At the end of 15 minutes thermometric readings were taken and the interior of the houses roofed with stone and tin showed a much higher temperature than those roofed with shingles. The house with the roof covered with painted shingles showed the lowest temperature. On account of the heat deflecting properties of shingles they will probably always find a wide application in warm climates, and the point was also made that shingled dwellings are much cooler in summer than ironclad or stone roofed dwellings.

A summary of the conclusions reached were given as follows:

The shingled roof is highly desirable on account of its durability, light weight, low cost and non-conducting properties.

Shingled roofs are subject to conflagration when they become dry. Hot cinders from chimneys or glowing sparks carried by the wind from nearby fires are common causes of roof fires.

The use of high-grade mineral paints upon shingled roofs eliminates such fire danger. Shingled structures of all types, when properly painted, are not only fire resistant but they are moisture proof and highly ornamental.

The painted shingle dwelling constitutes one of the most desirable types of modern suburban homes.

As a man remains in the employ of a firm, states the American Machinist, so his particular skill on his job increases. This skill does not represent an item of cost to the firm, but it does represent an asset; his skill and knowledge are direct money value to the shop where he is employed, and his departure diminishes the capital of the firm by that amount.

Management Engineering Applied to a Highway Contractor's Organization

By Henry B. Drowne*

THE fact that highway construction work looks simple and that only a relatively small amount of capital is required has led a large number of people to enter the field of highway contracting. Of this number some make a success, while others are a complete failure. Unfortunately the law of the "survival of the fittest" does not always apply, because there are instances of those who survive through the medium of dishonest work. Competition in this line of work is very close. The big contractor with large plant equipment and heavy overload charges must meet the competition of the small contractor who has plant enough to work only one job at a time and probably personally superintends the work. There is another class of contractors who make competition particularly discouraging at times by ignorantly bidding work at figures all out of proportion to the actual cost. This last class, however, is rapidly eliminated after trying to do work for which the bids have been too low. On account of the above conditions a contractor, who operates on a large scale, must have a sound system of management or otherwise he will be forced out of business.

The writer believes that any man or association of men who desires to enter the field of contracting should first incorporate, as there are several advantages gained thereby. An incorporated company would usually have as officers a president, vice-president, treasurer, secretary and general manager. There might be a man for each office or one man might occupy several of them, depending upon the size of the corporation.

No attempt will be made to outline in detail the duties of the individual officers of the corporation. Suffice it to say that at this point there should be two main divisions of duties into what might be called office work and field work. The office work would include all financial transactions of the company, such as obtaining credit, purchasing bonds, insurance, machinery and supplies and all accounting incident to the performance of the business of the company. The field work would include securing contracts and the planning and supervision of all construction work. The work pertaining to the first division is of a most important character and wise management and sound business in this department are in a large measure responsible for a company's success. On account of the brevity of this paper no further space will be devoted to this department. Consideration will be given to the management of the field work—that part of the work which is of more particular interest to engineers.

The generally recognized principles of good management are four in number and may be briefly stated as follows:

1. The equal division of responsibility between the management and the workmen.
2. The development of a science for each element of the work.
3. The selection, training, teaching and developing of the workmen.
4. The co-operation of the management with the workmen.

Briefly stated these rules may be applied as follows:

Usually the field work would be under the direct control of the general manager. A primary requisite to success is the ability to get contracts that will prove to be desirable work. It is difficult to make a poor job pay even under the best system of management although an intelligent contractor will sometimes take one in order to keep his organization intact.

Second to securing desirable work would be the formation of the organization by means of which the construction work can be done. The building up of the field organization would be part of the duties of the general manager and its personnel is important. It is necessary to carry a permanent force that can be depended upon from year to year, this part of the organization comprising engineers, general superintendents, superintendents, foremen and skilled mechanics. The size of the permanent force would vary depending upon the amount of work undertaken. In a progressive company the permanent force keeps growing proportionately to the increase in business.

The general manager should personally or through his immediate assistants, engineers or general superintendents, keep in close touch with each contract under construction. When a contract was secured, the machinery and tools necessary to do the work would be shipped to the job. Careful planning will save money that would otherwise have to be spent for new plant, as it frequently happens that some special machine can be worked to advantage on several jobs in the same season. The purchase of all material and supplies of any large amount would be done by those in charge of the office work, subject to the direction of those in charge of the field work. A superintendent, together with foremen and skilled mechanics, would be selected to do the work, and the approximate number of laborers necessary to start work would be determined upon. Questions arising relative to the interpretation of specifications, disputes with the party for whom the work is being done, estimating the amounts of work accomplished and the general planning of all the work would be attended to by either the general manager or his immediate assistants.

The foregoing shows to some extent the duties and responsibilities that would be assumed by the management. The superintendent who is assigned to carry out the plans on a contract would be selected on account of his fitness to do that particular job. Every man has his limitations and it is the knowledge of these limitations that enables a successful manager to place a man where he will make good rather than to place him where he will be a failure. Besides being a man of energy and resource, a superintendent should be a man of good character. A contractor's reputation rests to a considerable extent in the hands of a superintendent and a reputable contractor values in no small degree his reputation for doing honest and thorough work. The superintendent would be responsible for carrying out the work pursuant to the plans laid down by his superiors. Delayed shipments, break downs, weather conditions, change of plans and labor troubles all combine to interfere with plans made in advance and the superintendent would often have to use his judgment in dealing with such occurences until he could get in touch with those in charge of the field work. The cooperation of the superintendents, the foremen and skilled mechanics should always be sought in improvising methods to do the work in the most efficacious and economical manner.

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*Instructor in Highway Engineering, Columbia University; Engineer, Lane Construction Corporation.

The superintendent and his formen should use considerable care in selecting laborers to perform different parts of the work and have considerable patience in training them to do it. An efficient gang can be developed only by a continual process of weeding out the poor laborers and the proper selection and training of those remaining. Fortunately many laborers consider highway construction as a sort of trade and they follow the same line of work year after year. If treated right they will seek employment with the same company each season so there is generally a nucleus of experienced laborers available.

A good superintendent should always be cognizant of the cost of the work of each of his gangs and know whether the cost is out of proportion to the work that they are accomplishing. The gangs are never so large but that frequent inspection during the day and some mental calculation serves to show how work is progressing. Frequent visits by those in charge of field work would prevent slight errors on the part of the superintendent from becoming serious. Some companies require the superintendent to send to the office each night a daily report card showing the daily costs of doing the work. The writer believes that with a good class of superintendents who have the benefit of frequent conferences with those in charge of the field work the daily report card system is not worth the trouble. The superintendent should in any case divide the work of the day under several classified heads which would be determined upon by those in charge. If a report of these classified costs for each day were sent into the office only weekly or even semi-monthly, it would prove to be efficient.

The fourth rule, that embodying the co-operation of the management and the workman, is particularly important to all highway contractors' organizations. Construction work of this kind lasts only two-thirds of a year, yet it is remarkable how a reputable contractor will maintain his permanent organization from year to year even though his men are beyond his control for four months. The management must make the men feel that good and faithful work is appreciated and be quick to show it. Even the common laborer should not be forgotten. Although a bonus or other system of increased wages is rarely used by a highway contractor in dealing with his common laborers, the latter should be shown that those who excel gain the reward. Their efforts may be stimulated by seeing the cases of others of their class who are receiving increased pay or have been promoted to the position of foreman.

In concluding the writer believes that the basic ideas contained in the principles of good management previously mentioned in this paper, are fully appreciated and are put into practice by the intelligent and successful contractors.

In deciding to build the immense new dry dock, which forms part of Boston's port development, of reinforced concrete with wearing surfaces, or altars, of granite, photographs of reinforced concrete beams formed one of the determining features. These photographs showed that with proper mixing and treatment the combined chemical and frost action of sea water could be neutralized even when the material was subjected to alternate immersion under water and exposure to the air.

The Neglect of Brick Pavements

FROM recent inspection of a considerable mileage of brick-paved roads and streets, it appears to us, says The Engineering News editorially, that a very considerable percentage of the brick pavements recently laid are suffering deterioration because they apparently have had nothing at all expended on them for maintenance. On many miles of brick-paved roadways in Cuyahoga County, Ohio, which have been laid within a comparatively short time, and are good examples of first-class construction, the only defect noticeable is longitudinal cracks, extending usually along or near the centre of the roadway. So long as these cracks remain merely open cracks, they do no injury to the road and apparently nobody pays any attention to them.

What happens, in no very long time, however, is that the calks of horseshoes and steel tires gradually chip away the sides of the crack, and what has been a crack becomes a groove. As soon as the groove becomes wide enough for a steel tire or a horseshoe calk to drop into it, the destructive effect is rapidly accelerated. One sees not a few places on these brick roads where depressions half an inch or more in depth, and six inches to a foot in width, have been hollowed out along the line of what were originally mere cracks in the pavement.

This is, in fact, exactly what would naturally be expected to happen, and what is bound to happen so long as the fallacy obtains that a brick pavement once well laid needs no repairs whatever. It is entirely true, we believe, that such a pavement needs a comparatively small amount expended on it to keep it in good repair, provided it has been originally constructed in a first-class manner; but that small amount it must have, even though it be as little as $50 per mile per year, or damage will be done compared with which the cost of repair would be a mere trifle.

It would be an exceedingly easy matter when these longitudinal cracks form in a brick pavement, to fill them flush with the surface, either with a cement grout of the consistency of cream, or with a mixture of tar and sand in the same way that cracks in concrete roads are mended. From the practical point of view, the tar and sand is probably the best possible material to use. About the only objection that we know of is that it is more or less unsightly and brings the defect to notice just as it does when the same method of repair is applied to a concrete pavement. If cracks in concrete pavements could be filled with cement grout, so that the cracks would not be noticeable, instead of filling them with tar, which advertises the crack to everybody who passes over the road, the reputation of the concrete road would probably be a good deal higher, even, than it is.

Controller Hebert, of Montreal, estimates that the city has lost no less than "millions of dollars" on sewer contracts during the last quarter of a century. An investigation now in progress which has shown bad leakages is regarded by the Controller as "a drop in the bucket." It is stated that but for the expense and labor involved the Controllers would undertake an investigation of sewer contracts back to 1890.

Don Section, Bloor Street Viaduct, Toronto

THE illustration reproduced herewith is the approved design prepared by the Commissioner of Works, for the Don section of the Bloor street viaduct, Toronto. The length of the viaduct, out to out of the approaches, will be approximately 1,600 feet and the width about 86 feet. Down the centre of the upper deck there will be two electric railway tracks laid in ballast. Provision is also made for two 20-ft. roadways separated from the car tracks, and two sidewalks. The lower deck will be constructed to carry two lines of electric railway for radial traffic, freight or passenger. The viaduct will consist of five main spans, the greatest being 281 ft. 6 in., centre to centre of pins. The height of the roadway above the Don Valley at the deepest point is 125 ft. Approximately 5,500 tons of steel will be utilized in the construction of the viaduct, for which tenders will be called almost immediately.

Road Designing*

By Robert A. Meeker.

THE first point to be considered in designing a road is its width. It may be generally stated as axiomatic that the width of roads should be in multiples of eight, this being the width that should be allowed for each vehicle using the road. A road 8 ft. wide might more properly be termed a lane leading to one building or a small group.

The next in importance should be 16 ft. in width, in order that two vehicles might have sufficient width in which to pass.

The third width, or 24 ft., would permit of two vehicles passing while the third was standing along the side of the road—or two loads of hay or other bulky material to pass.

The fourth width, or 32 ft., permits two vehicles to stand along the sides and leaves sufficient space for two other vehicles, moving in opposite directions, to pass each other in safety. These widths refer to the traveled carriageway alone, no allowance whatever being made for the accommodation of pedestrians, nor for any drainage structures.

In order to obtain a roadway of sufficient width to accommodate travel passing in both directions, 24 ft. may well be taken as the minimum allowable, and if there is the prospect of an increase of traffic in the near future, a proper addition to the width of the surface, necessary for the accommodation of the traffic, should be provided for in the original design. It is almost impossible to properly grade and drain a road of less than 24 ft., and the wider the roadway the more easily it is drained, and also maintained, due to the fact that the surface is more freely exposed to the drying action of the wind and sun, thereby preventing the formation of mud and ruts.

The second problem is that of the location of the line. On a new road this is determined by certain well-defined principles. First, the beginning and ending points should be connected by the most direct line; second, the grades should be kept as low as possible; third, for economy's sake, the line should be so located as to reduce the amount of grading to the minimum, likewise the number and size of the bridges.

The factors governing the departure from a straight line are many. In crossing a ridge we seek the lowest point in the summit, in order to avoid expensive cutting or the alternative of steep grades; in following a valley we keep well up on the hillside, to avoid bridging ravines and small water courses; if we encounter a swamp or pond we can frequently, by swinging the line, save the expense of a heavy fill; a stream may be avoided by diverting the line, thus saving the cost of bridges.

On an old road another set of problems has to be solved; these are chiefly those of expediency. Though a straight line between the termini may not only be

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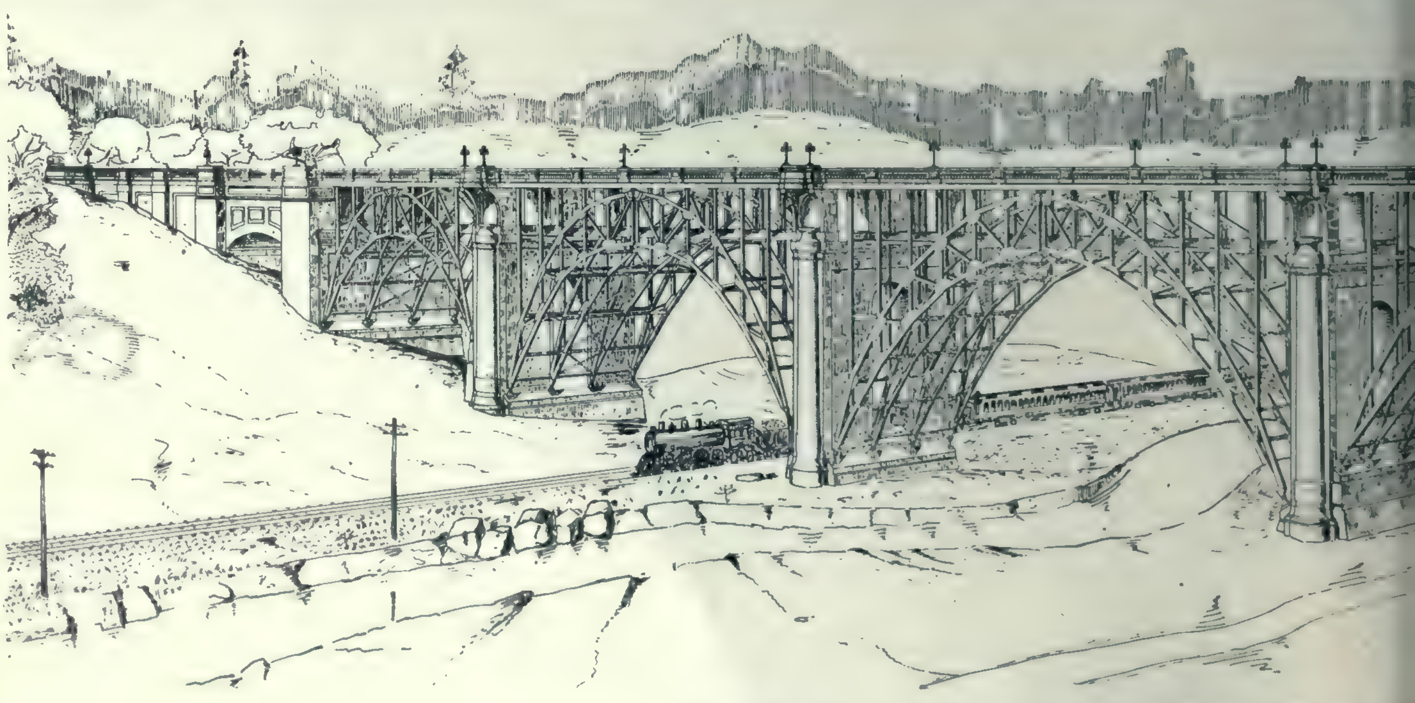
*Paper presented at the First Canadian and International Good Roads Congress at Montreal.



Sketch of the Don Section, Bloor Street V the best but also the cheapest, the claims of intermediate communities may be so strong that the line must be diverted from its best course to satisfy the wants of the communities to be served. But through it all, in spite of all of these warring factors, the engineer must never lose sight of the srtaight level line between two points as his ideal. By keeping this constantly before his mind's eye the results that may be achieved will often surprise even the author.

Grade

The grade, or the angle which the axis of the road makes with a horizontal line, is the most important economic feature in road design, for upon it depends the amount of material a horse can draw over the road. The results of experiments made both in England and France prove that a horse can haul twice as heavy a load up a 2 per cent. grade as he can up a 6 per cent. grade. That being so, the value of a road for heavy traffic, having a maximum grade of 6 per cent., is only one-half of that having a maximum of 2 per cent. This fact is often lost sight of in designing new grades, the object of many road officials being to build as many miles of road as possible for a given amount of money, the first cost, and not the ultimate value of the road to the community, being the basis upon which the improvement is made. This cutting down of hills and the filling of valleys or reduction of gradients is no new idea, for Isaiah wrote, over 2,000 years ago, his idea of a perfect highway as follows: "Every valley shall be exalted and every mountain and hill shall be made low; and the crooked shall be made straight, and the rough places plain."

Drainage

Having laid out your road as straight as possible, and having reduced your grades as much as your funds will permit, the next important problem is that of drainage. This is of two kinds—surface and subsurface. Surface drainage is both transverse and longitudinal. Every road must be so planned that the water which falls upon its surface will not remain upon or along it. The first object is attained by giving the road a proper crown or cross section, so that the water may be conveyed quickly to the gutters on the sides. This crown should have the form of the arc of a circle, drawn through three points—the center of the road and the gutter on either side. The elevation of these points should be in the following ratio: For earth roads a fall of 1 in. per foot from the center to the gutters; for water bound macadam, ¾ in. per foot, and for bituminous concrete ½ in. per foot. This form of cross section permits of the fullest use of the road, and at the same time conveys the water to the gutters without washing the sides or shoulders of the road. The longitudinal surface drainage is taken care of by the gutters, which must be carefully trimmed to conform to the grade of road, all holes being carefully filled and all humps cut off. In fact, the gutters must be as carefully graded as the center of the road. Proper inlets to bridges crossing the road should always be constructed if the bridge is as wide as the carriageway. In some soils these precautions are not sufficient, and we are then compelled to lay underdrains. These should be placed about 3 ft. inside of the gutter line, for two reasons: First, to intercept the subsurface water before it reaches the middle of the road, and second, to prevent erosion in case the gutters are gullied. The object of underdrains is to cut off the sub-surface water before it can get beneath the traveled road; therefore their place is on one or both sides of the paved way.

The Pavement

The last thing to be considered in the designing of a road is the pavement. This will depend upon the kind and amount of traffic. For country roads gravel or plain macadam is sufficient. For suburban and small town roads a surface treatment, either with bituminous or lignin binders, will suffice; if the traffic is great, bituminous concrete or brick, and in and near large cities, where the traffic is very heavy, stone blocks.

upon which tenders are about to be called.

Analysis of Worn-Out and Ravelled Macadam Surfaces, with Suggestions as to Treatment

THE word ravelling is used rather loosely. I shall consider it as the loosening of the bond of a road surface until the macadam stone lies loose and free on the road. By macadam stone, is meant, not the small stone used to fill voids and give a smooth finish to the surface, but the stone that constitutes the body of the road's surface. In macadam work this stone when compressed to its final form occupies about 60 per cent of the volume of the road surface. The 40 per cent of voids is filled in varying proportion with surface stone, screenings, stone dust, sand, earthy materials and any chemical binder used to "hold the road." The mixture of fine stone, sand and earth filling the voids has no appreciable tensile strength. Its duty is to wedge the macadam stone in place and prevent internal movement. Such a structure is called on to carry loads, to receive and absorb propelling thrusts. The road should be of sufficient depth to transfer the stresses thus imposed to the sub-base without serious internal movement and at unit pressure less than the resisting power of the soil. It is thus subjected to vertical and horizontal forces that contribute largely to ravelling. Let us briefly consider these.

A draft horse weighing 1,200 lbs. will have all his weight at one time on two feet. He will exert say 1 h.p. at a speed of 4 miles. The vertical forces at the foot is 600 lbs., the horizontal $\frac{23,000}{2 \times 4 \times 88} = 47$ lbs. These forces are or may well be concentrated on a toe calk 2 ins. in width; the resultant force slightly exceeding 300 lbs. per linear inch.

A motor truck weighing, loaded, 16,000 lbs. and exerting at the wheel rims say 30 h.p. at 10 miles an hour, will with 60 per cent of load on rear axle, exert a vertical force of 4,800 pounds and a horizontal of 562.5 lbs. at each rear rim, the resultant being about 800 lbs. per lineal inch for 6-in. tire.

For a pleasure car weighing 4,000 lbs. with 60 per cent of weight on rear axle and exerting 40 h.p. at the wheel rims with a speed of 35 miles, the vertical force at each wheel is 1,200 and the horizontal 214. The resultant is about 400 per linear inch for a bearing width of 3 ins.

At curves with high speed cars, the horizontal force is considerably increased, for it is impossible to so "bank" a curve as to suit the speed of all classes of traffic. In the case of wheels transmitting vertical loads only, observation indicates but little dust raising from a road not overlaid with loose dust. Such a wheel will at the point of mathematical tangency have no velocity relative to the road; a vertical velocity is imparted to it and as any section leaves the surface it will raise with it any of the lighter particles that are loose and may come into contact with it. At the driving wheel there is a slight slip which in addition to lifting will throw particles backwards.

These are the forces tearing at the road surface. In some cases they are more than the road can stand. The horse's calk acts somewhat like a chisel. It will pry out the binding material between the stones as well as the latter themselves when the bond is weakened. The driving wheels of motor vehicles push or suck any material thus loosened out of place. The binder loses weight as it parts with moisture; besides this, without moisture it also loses, not only its property of recementing itself under pressure but to a great extent, its binding power as well. The real work of transmitting the stresses due to traffic must be borne by the stone. These are merely held in place by the binder. The latter is gouged out by the horse, drawn or pushed out by the automobile tire, blown away by the wind, or washed off by the rain and a loosening of the upper stone results.

Even on a well consolidated road climate stresses impose a heavy duty. If, however, there be voids the risk of failure increases. Voids may be due to deficient rolling or to the rise of too much clay in the earthy binder. Lumps of this material will bridge the spaces between stones even under hard rolling. The bridge will break down eventually either from pressure or moisture or a combination of them. A void forms where the bridge was and continues rising until near the surface when ravelling results. The same may be true in the cases of too light rolling.

In considering the effect of overloading and neglect it must be borne in mind that any given type of construction may be so maintained as to vastly increase its carrying capacity. The problem is largely one of economics and administration. As an illustration, assume in two cases the same foundation—let one road have a water bound macadam surface dressed with a heavy bitumen forming a sheet about ½-in. in thickness and the other a bituminous concrete (mixed method) surface of say 2 ins. The former will cost about $0.40 for stone and $0.15 for dressing, or $0.55 per square yard, and the latter about $1 (both exclusive of the foundations). With proper care the higher surface will last about three years under fairly heavy traffic, the heavier one an unknown period, but let us assume twelve years. The total yearly charges against the two may then be stated about as follows:

Dressed Macadam—	Cts.
Interest on cost, 55 cts. at 4 per cent	2.2
Depreciation, one-third of 15 cts	5.0
Labor (patrol system)	1.9
Materials:	
Stone ⅜ cu. ft. at 9 cts	3.4
Bitumen, ⅛ gal. at 12 cts	1.5
Total	14.0
Bituminous Concrete—	
Interest on cost, $1 at 4 per cent	4.0
Depreciation, 1/12	8.3
Labor	0.9
Material	0.8
Total	14.0

The fixed charges are 6.2 cts. against 12.3 cts.

The operating charges 6.8 cts. against 1.7 cts.

I do not claim that these figures are more than illustrations of the principle involved. They show a great saving in operating charges, those that show up in the yearly tax bill. The fixed charges, however, are just as real and must be met at some date.

For a road with 9,500 sq. yds. per mile the costs as shown in yearly tax charges, where depreciation and interest are not visible, would in this case be,

For the dressed macadam, per mile	$636.50
For the bituminous concrete	161.50

yet as shown above the real cost of the two roads is the same. This case affects our subject because the treatment of a ravelled road surface must depend on the system of maintenance.

In most communities the great consideration is the next yearly tax bill. If that can be kept down for a period the ultimate economy of such a policy receives but slight attention. It is generally easier to get money for a new road than for repairs. A road requiring a large yearly repair charge is condemned without a hearing. The road calling for heavy interest and depreciation charges may be an equally or even more expensive solution; but the interest charge is not so apparent and the depreciation charge is not made. This is simply putting off the day of reckoning which is sure to come. However, the troubles of those in charge ten years hence are usually lightly borne by the officials of to-day.

If we consider the structure of the road surface we can easily see that the 40 per cent of voids in the macadam stone will be filled somewhat as follows:

	Per cent
Surface stone pasing 1-in. ring and caught on ½-in. ring	15 to 20
Screenings, passing ½-in. ring	15 to 10

When dry the clay is driven off to a greater or less extent as dust washed away or splashed off as mud. Its place is supplied to some extent by detritus, the result of the wear of the larger and heavier materials. These also blow or wash away and the road loses its bond. If our road is not overloaded we can retain its usefulness by making good its losses, with proper materials in their needed proportion. It is here that the trained road man is most needed. Nothing can replace his experienced judgment.

In the case of a ravelled road having first determined that the road was well built we must decide whether the traffic is too great for the type of surface, or whether the failure was due to neglect. If the former we must resurface with some better type. If the latter we can repair the old surface.

Resurfacing should always be preceded by scarifying and by bringing the road up to the necessary depth of stone. For water bound macadam needing greater surface strength several classes of chemical binder may be used of which I shall discuss two—bitumen and lignin.

The bitumen may be applied either by penetration or mixing methods. The former is the cheaper, the latter the more trustworthy. Which method is to be used will, after consideration of the care the road will receive, depend on the estimate of the overload, as will also the depth of the bituminous sheet. My own observation leads me to question the wisdom of attempting to get any thickness exceeding one-half inch by penetration methods. It also leads me for this class of work to prefer tar to asphalt. The former material appears less sensitive to injury by dirt and to yield better results in repair work.

The lignin binders are derived from the waste products of wood pulp or tannin manufacture. They are cements being also used to bind core sand in foundry work and impart a tensile strength to the binding materials. They will not act on materials soaked in the so-called road oils. The action of some of these materials on slag and red shale is quite remarkable. They are slightly soluble in water and will therefore need renewal. Their application, however, is easy and inexpensive and the effect of successive applications seems cumulative, increasing not only the depth of penetration but the strength of the bond. The waterproofing of lignin bound roads with bituminous tops has been carried out in Connecticut but I am unable to give any facts as to the results.

For water bound macadam roads that have failed through neglect a thin coat of gravel carrying some earthy matter or of screenings or coarse sand mixed with earth will usually cure cases that have not gone too far. In some of the counties of New Jersey it is usual to fill all ruts, etc., with fine stone and to give the middle of the road a coat of the same mixed with a little clay. Much of this material is wasted by being thrown off the road by the traffic, and old ruts almost invariably reappear. This method, however, is very successful in preventing ravelling. It seems a false economy to omit rolling and wet rolling, at that. The same is true of patching holes with anything but macadam size stone. The roads treated with small stone are yearly losing depth. The moisture for wet rolling is usually bountifully supplied by nature in the early spring. It can also be had by the use of hygroscopic salts where water is hard to get. Traffic will usually throw off from the road surface enough stone to pay for rolling.

A treatment of clay, without rolling, will often give astonishing results. Such treatment, however, seems only a palliative not a cure. Roads thus treated become dusty or muddy according to the weather, show a tendency to ravel again and are hard to properly treat with bitumens. They will, however, take the lignin binders with good results, if the dose of clay has not been excessive, or if the excess is swept off before treatment.

Brick roads in Cuyahoga County, Ohio, will be increased 60 miles in length during the present season, according to the plans recently announced by the County Engineer. There are already about 400 miles of brick pavement in the county. A minimum width of 16 ft. has been adopted for the new roads. The present season's work will amount to about $900,000.

Gas in a deep cesspool in East St. Louis caused the death of the contractor who had built the cesspool, and of two other men. The contractor, discovering that a tool has been left at the bottom of the pit just completed in the rear of a grocery store, started down a ladder to recover it and was overcome by gases and fell into about 6 ft. of water. One after the other, two assistants who attempted to rescue him were overcome and fell. A fourth man was pulled back unconscious, before falling. The pit was 22 ft. deep by 18 ft. in circumference and connected to an old cesspool. It is supposed that the fumes came through the connecting pipe after the water in the old pit had run into the new. A lighted lantern is said to have been extinguished by the fumes.

Suit is being brought against the city of Chatham, Ont., to prevent the corporation from emptying sewage into the River Thames. The Provincial Officer of Health states that it is illegal for the city to pour sewage into the river, but in view of the fact that it cannot call a halt to the practice without creating a greater nuisance, he is of the opinion that reasonable time should be allowed to provide for suitable means of disposal. The action is a timely one, and we trust that the example will not be lost upon many other municipalities throughout the province.

Grades and Leakage in Intercepting Sewers

By J. N. Ambler, Winston-Salem, N.C.

IN spite of the view of many authorities that extremely flat grades are practicable, in sewers of this kind, because of the greater flow, and the fact that the sewage has become thoroughly macerated by the time it reaches the interceptor, the writer is thoroughly imbued with the belief that all the fall available should be obtained. This belief rests on his experience in cleaning out intercepting sewers after having been in use, and, of course, neglected, for many years.

All the sand, mud and illegitimate matter of all kinds which gets into the various closets, or through the manholes in the streets, is pushed down the sewers of sharper grade, and finds a resting place in the interceptor.

The writer once removed some twelve of fifteen hundred bushels of such substances from about half a mile of old interceptor. Most of this was sand, but bottles, rags, straw hats, overalls, stones, wooden articles, etc., were also present, and the capacity of the sewer was greatly reduced.

Of course, hard and fast rules cannot be laid down, but the writer does not feel good in laying a grade as flat as 1 foot per 1,000. It is his endeavor, in the light of experience with cleaning, to get all fall possible.

From the very nature of the low, level intercepter, it is usually located where the ground is alluvial, and with the ground water level near the surface.

In many cases the ground to be traversed is marshy, and in nearly every instance the sewer is laid below ground water level.

These conditions are distinctive for the style of work and require special methods of treatment.

Unless the joints are laid very perfect, and so maintained at the flat grade as to utilize all the fall, without pockets, the infiltration of ground water will be so great as to greatly reduce the carrying capacity of the sewer, or even, in the case of a long line, to completely destroy its usefulness.

Settling of the joints will, of course, render the conditions worse, and may result in the inflow of quicksand until the sewer is put out of commission, as in a case which once came under the writer's charge for correction.

It is, therefore, of the utmost importance, not only to have perfect joints, reducing the inflow of the ground water to a minimum, but also to provide means to maintain the grade as a perfectly straight and rigid barrel, free from settlement.

The difficulties of meeting this last requirement are often very great, as usually the bottom of the trench is a water-soaked quagmire and frequently quicksand.

Considering, first, the question of perfection in the joints, the writer has specified a mortar of neat Portland cement, on account of its density and imperviousness.

The shrinkage of neat cement mortar being considerable after the mortar is set, a wash of thick grout is used to fill the cracks.

The entire circumference of each joint is rigidly inspected by hand, and no imperfect joint is left on the work.

Special compounds, as melted sulphur, and the various elastic compounds from which it is claimed that perfect joints may be made, even in water, were not tried, either on account of the expense, or because there was doubt felt as to the durability of such substances.

Feeling the necessity of having some criterion upon which to base the engineer's acceptance of the work, so far as ground water is concerned, the writer read up all available data on ground water flows, and came to the conclusion that it is a subject about which too little is known, and what is known is conflicting.

There should, however, be some criterion to apply to work done by contract, and it seemed that nothing better could be done than to determine how much water the sewer might be allowed to carry without materially injuring its usefulness. The criterion should not be so severe as to greatly affect contractor's bids.

Such a criterion, it would seem, should be based upon the number and circumference of the joints.

The following clause appears in one of the writer's specifications, and is offered for what it is worth, until something better can be substituted. It, at least, has had the effect of securing some very careful work, and contractors were not disposed to regard it as severe when thoroughly explained to them.

The clause is as follows:

"It is the intent of these specifications that no more leakage of ground water into the sewer be allowed than is admissible with a first-class piece of work, in which care has been exercised to get as near as possible to a water-tight result.

"To determine the admissible amount of leakage, the length of a joint will be considered as the outside circumference of the spigot end of a pipe.

"Leakage not in excess of two gallons per day of 24 hours for each foot of circumference of every joint will be considered admissible, the amount of flow to be determined by the engineer's gaging in each section, by means of a notch board.

"The contractor agrees that for each 10,000 gallons per day of 24 hours by which the total flow of the sewer exceeds what the total flow should be, when figured on the basis already given, a deduction of $100 from the contract price will be made.

"This will not apply further than to a total flow resulting from three gallons per day of 24 hours, from each foot of joint length, beyond which figure the sewer will be regarded as not in compliance with this contract."

The writer's opinion is that the above requirement is a very mild one, as he once laid a mile of large sewer through exceedingly swampy land, passing under several streams, etc., with a result that not more than a stream one-fourth inch deep was flowing in the bottom of the pipe at the lower end on completion.

However mild the criterion may be, it has had a powerful deterrent effect against bad work.

It is extremely important that the manholes should not leak. To prevent this, the best hard bricks are used, each being dipped in a pail of water, as handed to the mason.

The brick work rests on a cement bottom 12 inches thick, with a solid cement invert and the contact of the pipe with the masonry is an object of especial care.

Manholes are built up sufficiently high above the meadow to prevent being stopped by floods.

The caps are secured to the covers by two set screws to prevent malicious persons from placing foreign substances in the sewer.

The handling of water in the trench during construction is usually less serious than the inexperienced are apt to imagine. A diaphragm pump connected to a small gasoline engine is the cheapest and best way known to the writer for removing the water. A small trench is excavated along the side wall of the main trench which conducts all accumulated water to a pump, where it is promptly removed by pumps, without being allowed to rise on the freshly constructed sewer line.

The writer has used the pile and platform method of founding, and finds it of very general application, of moderate cost to handle, and very satisfactory in result.

Softening Water Supplies*

Action of Permutite and Allagite in Removing Hardness

THE hardness of water, as is well known, is in proportion to the lime salts and magnesia salts dissolved therein. We distinguish between temporary and permanent hardness. Temporary hardness is due to the presence of dissolved bicarbonates of lime and magnesia which, when the water is boiled, are changed to insoluble carbonates, which then are precipitated. Any remaining hardness is the result of dissolved sulphates of lime and magnesia, which, when the water is boiled, still remain in solution therein.

Recently two new processes of water purification, which are essentially different from those hitherto known, have been devised. They are known as the "Permutite" and the "Allagite" processes. Both are based on the properties of certain substances to absorb the hardening elements (lime and magnesia) in the water and to give up to the water a harmless substance, soda.

In testing several natural zeolites Dr. Gans discovered that, as regards their ability of taking up bases from aqueous solutions, they had very different properties. Based on these discoveries Dr. Gans classified the zeolites into aluminous silicate and double silicate of alumina. In the first class he placed such zeolites as hold their exchangeable bases combined with silicic acid.

He endeavored, then, to produce on artificial product which should be practically available, by making artificial chabasite, which in nature belong to the group of alumina silicates.

On a commercial scale this product can be made by melting together three parts of kaolin, six of quartz and twelve of sodium carbonate. The resulting melted mass is made into a lye with hot water, for the purpose of hydrating it and removing any soluble silicates. By washing and handling in a centrifugal, the remaining granular material is freed as far as possible from the final alkaline lye, then stored in a moist condition. In this manner there is formed an artificial aluminum silicate, which is put on the market under the name of "permutite," in the form of white, sometimes granular, sometimes lamellar crystals. This artificial product possesses in a high degree the property of taking up lime and magnesia from aqueous solutions, and replacing them with a corresponding equivalent of sodium in solution.

Softening the water by the aid of permutite is effected by passing it slowly through filter beds of the permutite. In its passage through the permutite the water gives up to the latter its entire contents of dissolved lime and magnesia, in exchange for which the permutite yields up to the water the correct chemical equivalents of soda. Chemically speaking, the sodium atoms combined with the alumina of the permutite are replaced by lime and magnesia atoms.

The permutite is thus gradually changed from a pure sodium zeolite to more of a calcium-magnesium zeolite. When all the replaceable sodium atoms are supplanted by calcium and magnesium atoms, the peculiar property of the permutite is at an end.

In the practical use of this material, the softening process is naturally not carried so far as thorough exhaustion of the material. On the contrary, as soon as the water shows any traces of hardness (which may be detected by the use of ammonium oxalate or by a soap solution) steps are taken to regenerate the permutite. This regeneration is effected by first freeing the filter from dirt, dust and the like, and loosening its texture by treatment with water, and then passing through it a comparatively concentrated solution of a sodium salt—preferably a solution of common kitchen salt (sodium chloride). There then results the converse reaction to the softening process above described. In the regeneration process the sodium atoms of the saline solution drive out from the permutite the previously taken up lime and magnesia atoms, and take their place. Thus, in the regeneration, the calcium or magnesium zeolite is again transformed into a sodium zeolite, that can be used again for water softening as at first described. While Dr. Gans manufactures artificial zeolite as a crystalline-lamellar substance and makes its property of exchanging atoms of practical use in purifying water, Kobelt, the inventor of the "allagite" process, takes another route. He made experiments as to whether besides the long known natural zeolite there were not other natural products which have the property of readily exchanging or replacing their bases; and found that the so-called "rock glass" or volcanic glass, also, operated in this manner. This, however, does not exist in already available condition, but must first, by a mechanical process, be purified from its inefficient materials. The material, separated from volcanic rocks by a simple process, is put on the market under the name of "allagite" and consists of a dark brown porous mass with grains about one millimeter in diameter. Chemically it differs from permutite in that, while the latter is a true chemical compound, allagite may be considered as a so-called permanent solution.

The method of using allagite for softening water is the same as that described for permutite. The same is true as regards its regeneration, which is effected by treatment with a 4 to 5 per cent solution of common salt.

But from another point of view the new softening processes are far in advance of the usual lime and soda method. In the textile industries (as silk dyeing), in laundries, etc., these two materials do away with difficulties where other processes do not. Outside of softening the water, they can remove iron and manganese. Most surface water contains iron in the form of dissolved oxide compounds; usually carbonates and sulphates. If the water comes in contact with the air, the dissolved iron precipitates and leaves the originally clear water cloudy and muddy in appearance, and useless for most industrial purposes. Further, the conduits are fouled by the iron precipitates.

Such water has been freed from iron and manganese by aeration by well known processes, but these do not, as a rule, effect perfect deferrization of the water. In particular, water that has in solution iron in combination with organic substances is very difficult to free from that metal. Often the filtration is attended with difficulties. For this reason the permutite manufacturers have put on the market manganese filters which are saturated with higher manganese oxides. By simply passing the water through the permutite filter it is freed from both iron and manganese. The manufacturers suggest first adding to the water, very gradually, a very dilute solution of potash permanganate. This facilitates the formation of fine colloid precipitates of manganese hydroxides, which are favorable to the separation of the iron. The small amounts of manganese introduced into the water by the permanganate are absorbed by the permutite. The precipitated iron collects principally in the upper filter layers, from which it is removed from time to time by washing.

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* By Robert Grimshaw in the Municipal Journal.

When the manganese filter is exhausted—which occurs when the oxygen of the higher manganese oxide has been taken up by the iron—the filter is regenerated by treatment with permanganate of potash or of calcium. In this regeneration, the lower manganese compounds in the filter are changed into higher oxygen compounds.

"Oxyd-allagite" contains, also, higher manganese oxides, which, in the same manner as above described for permutites, give up oxygen and change the soluble suboxide iron compounds into soluble oxides and hydroxides, which precipitate.

While the manganese is artificially introduced into the permutite filters, the natural allagite filters already contain manganese; so that allagite is made ready for use as a deferrator and demanganator by simply treating it with permanganates.

If the permutite and allagite processes are compared, it appears that they give equally good results in softening, deferrating and demanganating water. The allagite process has the advantage, when used on carbonated water, that allagite is perfectly resistant to acids, while permutite is attacked by them.

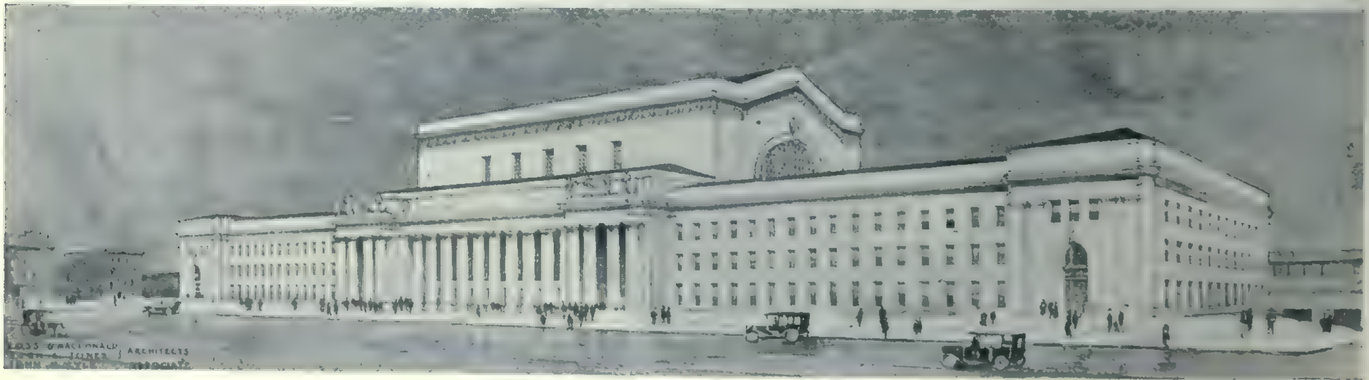
Montreal Firm Secures Canada's Largest Building Contract

TO a Montreal firm, the Peter Lyall and Sons Construction Company, Limited, has fallen the honour of securing the largest building contract ever given out in Canada—that of the Grand Trunk and Canadian Pacific Railways Union Station at Toronto. The competition was particularly keen, tenders being sent in by some of the principal building firms in Canada and the United States. The following firms put in bids:—The Peter Lyall and Sons Construction Company, Montreal; Geo. A. Fuller Company, Montreal; Norcross Bros., Montreal; Hedden Construction Company, New York; The Thompson Starrett Company, New York; John Parker & Company, New York; Megann-Wells Construction Company, Toronto; John Griffiths & Sons, Chicago; The Leonard Construction Company, Chicago; T. C. Wills & Company, New York; the Canadian Stewart Company, Montreal; and William Crawford, New York.

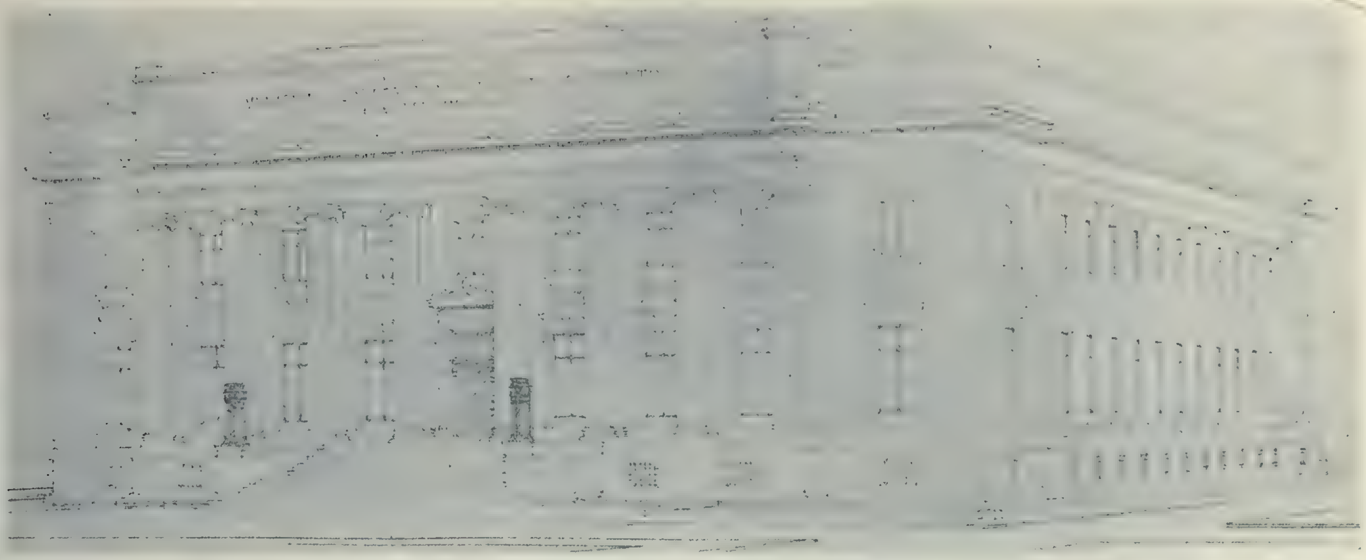
The contract price of the successful firm, of between three and four million dollars, was the lowest sent in. Work will be commenced at once, and the first section will be completed in two years.

In our issue of May 6 we gave a detailed description of the proposed station, the plans for which were drawn up by Messrs. Ross & Macdonald and Hugh G. Jones, of Toronto, with whom is associated Mr. John M. Lyle, of Toronto. The problem was studied for several months and involved visits to some of the principal United States cities, where similar traffic is handled. The architects found the Toronto passenger traffic equal to that of Washington, D.C., and about half that of St. Louis or Kansas City. The baggage business is very heavy and equal to that of the Pennsylvania Station at New York. The average number of pieces of baggage or parcels per passenger is greater at Toronto than at any other station on the continent. The traffic handled at Toronto is abnormally heavy during certain seasons of the year, and for this reason the new station will be built larger than is ordinarily necessary, thus enabling the business at all periods to be handled with ease. The idea of complete separation of traffic is the dominating one in the design of the station. The problem was studied under the criticism of Mr. Howard G. Kelly, vice-president of the Grand Trunk, and Mr. Leonard, assistant to the vice-president of the C. P. R., while Mr. H. R. Stafford, chief engineer of the former line, and Mr. J. R. Fairbairn, assistant chief engineer of the C. P. R., were associated with the architects in the solution of the engineering points.

The contractors are one of the oldest building firms in the Dominion, the business having been founded by the late Peter Lyall in the early eighties.



Architects' perspective of the proposed Union Station, Toronto.



The City of Toronto's proposed Registry Office.

They have carried out some of the largest contracts in this country, including the Dominion Express and Transportation Buildings, Montreal; the Central Union Station, Ottawa; the Saskatchewan Parliament Buildings, Regina; the Royal Victoria Hospital, Montreal; the C. P. R. station and offices, Winnipeg; the G. T. R. offices, Montreal; the Technical School, Montreal. At the present time they have in hand the new customs warehouse and the Sun Life Biulding, Montreal, two of the most important structures of this season. They are exceptionally well equipped for undertaking large contracts, having their own carpenter, marble, stone crushing and stone departments. At the beginning of the year, work to the value of $3,300,000 was in hand, and with this new contract the firm will have secured more business than any other Canadian building firm this year. Mr. William Lyall, the President, has been associated with the business all his life and during his father's later years was managing director.

Proposed Registry Office, Toronto

WE reproduce herewith the architect's perspective for the new Registry Office, Toronto, tenders for which are now being called and close on the 18th instant.

It will be remembered that the design for this building was selected after a competition in which Charles S. Cobb, of Toronto, obtained the first prize; Messrs. Chapman & McGiffin, of Toronto, the second prize; and Messrs. Symons & Rae, of Toronto, the third prize. The estimated cost of the building is placed at $400,000. The requirements of this building are peculiar in that there is to be housed under one roof duplicate organizations similar in every respect, one for the registry division east of Spadina Avenue, and the other for that west of Sapdina Avenue. As stipulated in the programme, it was thought desirable to face the building toward the south, so that the conditions required a structure symmetrical about a centre axis running north and south, and the accepted design is a direct solution of these requirements of plan. The design, however, has one major feature which peculiarly enough was overlooked by most of the competitors in the competition, and that is a well-marked separate entrance for the clerical staff, which allows them access to the building during hours when it is closed to the public, and thus obviates troublesome interference. The searching office has light and natural ventilation on all three sides.

The elevation on Albert Street is a Roman octostyle portico, while the lateral facades on Elizabeth and Chestnut Streets are treated in a simple way with ten pilasters, embracing with their corner piers the entire length of these elevations.

The population of the United States on July 1, 1914, was 109,021,992, according to estimates made by the Bureau of Census, Washington, D.C.

A cheap concrete warehouse, 1,000 feet long, on the property of the Southern Pacific Terminal Company at Galveston, Tex., divided into four compartments, complies with underwriters' requirements and was built at a cost of slightly less than $1 per square foot. The floating foundations are supported on a sandfill dredged from Galveston Bay.

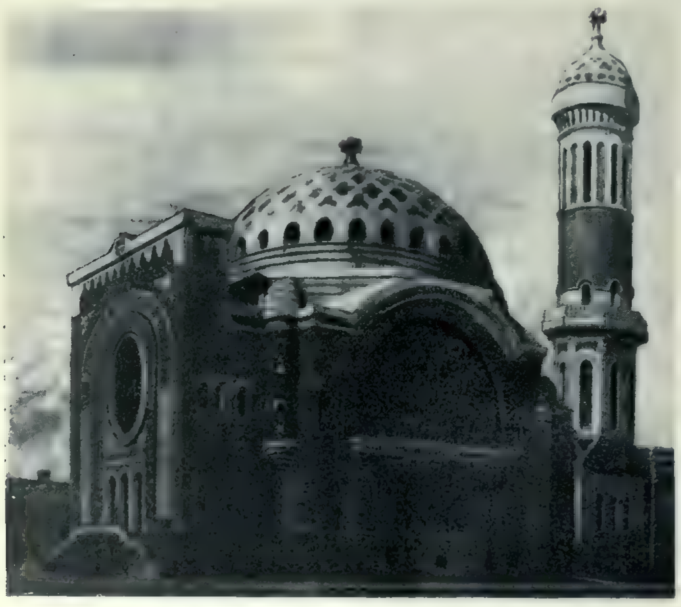
In the removal by blasting of a reinforced concrete bridge pier 37 ft. long, 30 ft. wide at one end and 17 ft. wide at the other and 16 ft. thick, which had fallen over on its side and was blocking a river channel in Indiana, the dynamite was placed in a rather unusual manner. In half-bushel market baskets mud was laid on the bottom and sides; dynamite was then placed on the bottom mud and covered with more mud. The baskets were then lowered against the concrete pier and the dynamite discharged. This method was successful in pulverizing the concrete so that piles could be driven through it, and new piers constructed on the site of the old ones.

The Pan-American States Association building, which is to be erected in New York, is to be the tallest building in the world, if we disregard the Eiffel Tower, in Paris, which is not really a building at all in the usual sense of the word. The Pan-American building will have fifty-one storeys, two or three of which will be under ground. The height, including the human figure at the top, is 894½ feet. The Eiffel Tower is 984. The Woolworth building, although it claims six more storeys than the Pan-American, is but 750 feet high.

St. Michael's R. C. Church, Montreal

THE accompanying cut of St. Michael's Roman Catholic Church, to be erected at the corner of St. Viateur and St. Urbain Streets, Montreal, from designs by Messrs. Beaugrand-Champagne and Chenevert, Montreal, shows a building in the Byzantine style, which marks a complete departure in ecclesiastical architecture in the city. The church will be entirely of reinforced concrete, which, too, is a departure as regards this class of building. The exterior will be of Greendale Rug brick, with stone trimmings and insert panels, decorative in design, composed of different coloured terra cotta. On the front elevation, on St. Urbain Street, there is to be a wide panel of terra cotta with the inscription "Deo dicta in honorem Sti. Michaelis"—"Dedicated to God in honor of St. Michael."

Two features are the central dome, of concrete waterproofed, 75 ft. in diameter and 104 ft. in height from the floor, and the tower 160 ft. high. A shamrock design will be traced on the dome and the cap on the tower.



Proposed St. Michael's R. C. Church, Montreal.

The interior walls will be lined with marble, from the floor to the springing of the main arches supporting the dome. The vaulting and spandrils will be of tile specially made for the job. The dome will have a double shell, and the inside one and the cupola over the choir will be decorated with paintings of sacred subjects. Three large stained glass rose windows will give ample lighting to the interior. The vestibule, main and choir floors will be of Flemish tiles, and marble steps will lead from the auditorium to the choir, which will be 53 feet wide and 33 feet deep. The main floor surface is to be 171 ft. 6 in. by 90 ft., and every worshipper will have an unobstructed view of the fine altar.

The baptistry will be on the St. Urbain street side of the choir, immediately under the tower, while the sacristy is on the opposite side. The organ tribune is to be placed over the vestibule.

Lighting is to be by electricity, and artistic fixtures will be suspended from the roof. Carrying out the object of making the building fireproof, the doors and window frames will be of bronze. There will be five entrances leading into the main building, three in front and two on the sides.

The ground floor is supported on the basement by reinforced concrete arches of 54 feet span, thus avoiding the use of pillars. The church will have a seating capacity of 1,300 and the basement (which will be 15 feet high) of about 1,100. The basement will be used as a temporary church while the main structure is being erected and afterwards for social church purposes.

What is an Architect?

By Joseph Losekann

TO begin with, an architect is a man, or woman for that matter, who has made a thorough study of all branches of the construction of buildings and has had the practical experience as well. He should have studied architectural design through all its evolutions from long before the Christian era and before Egypt itself, through the different periods to the present day, and should embody in his design of a building that which is essential for its present needs and style, having learned from what has been done in the past and erect a building that should stand as a monument for the future. It should be modern in appearance as well as in material in order to meet the present-day requirements.

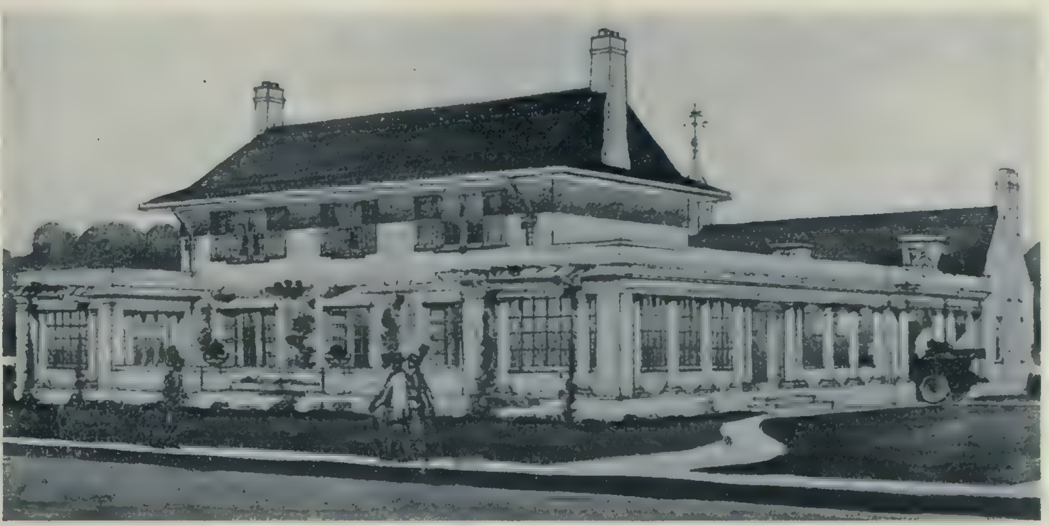
An architect must thoroughly understand building construction—a most vital point—as a building poorly put together is little better than no building at all. He should understand the weight and strength of materials, in order to properly apply them and make the building he is constructing a complete whole.

He should understand the planning of a building, which requires thorough training and experience, without which no building can be successful unless its arrangement of plan is simple and economical. The successful plan, therefore, is the one that meets all requirements as to beauty of design and good construction with the least expenditure.

The architect should understand and know of all the different materials that enter into the construction of a building and should specify and see that only the best are put in for the money. He should keep in touch with the newest materials through their many agents and by reading the advertisements, and should always be abreast of the times as to what is the very best and latest on the market.

He should be an impartial superintendent and work for the best interests of the owner, though with proper regard for the contractor as well. It is to the architect that all difficulties that may arise and the proper interpretation of the plans and specifications are left and it is the satisfactory handling of these things that determine the architect's real competency. Judgment should be rendered impartially and a firm stand taken to effect a speedy completion of all matters. The inability to decide quickly and finally on many small things is often the cause of unnecessary delay, and could be avoided by quick action on the part of the superintendent.

Finally, I would ask: Why should you go to an architect to have your plans drawn for a building when there are many contractors, carpenters and others that will make them for you without cost? By way of comparison let me ask, why do some people, when they are sick and in pain, go to a drug store for advice and medicine instead of seeking the professional services of a physician? To save the doctor's fee, of course. The druggist, except in exceptional cases, is not a doctor and does not understand the planning and arrangements of the human body. The



Residence to be erected at Regina for Mr. R. H. Read at a cost of $30,000.

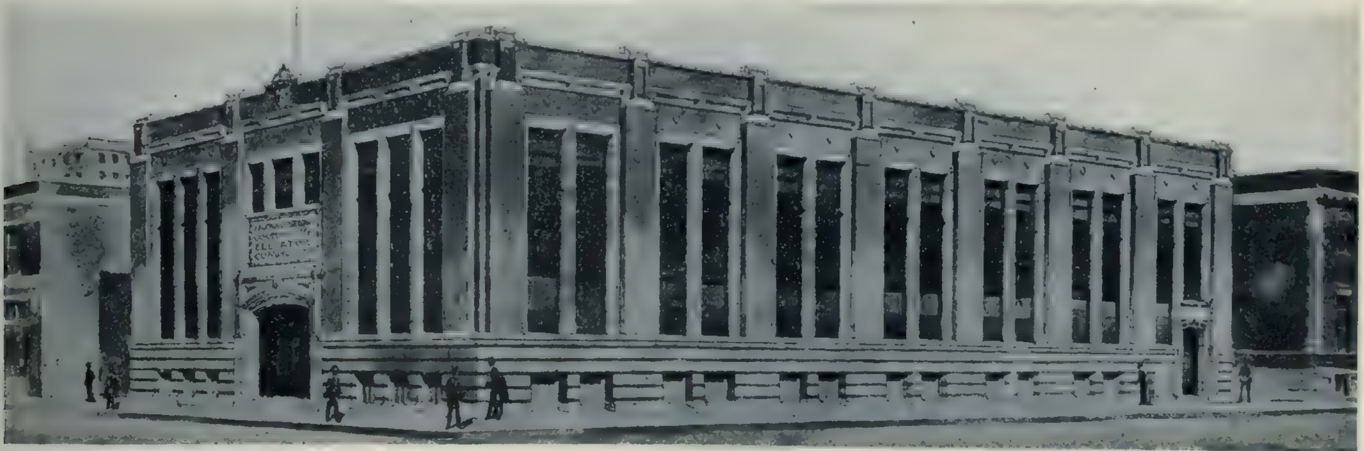
wise person is the one that goes directly to a good physician at the start and pays a reasonable fee for professional advice. The doctor furnishes the prescription as the contractor would construct the building, and the result is, the patient (owner) has a body (building) when properly attended to that is left in the best condition possible for the skill and money expended and in that he more than saves the doctor's (architect's) fee. Everything has been done by the right person in the right way and naturally is bound to bring the right results.

Structural steel frames of very considerable size and complication of design are being used in Europe as hangars for large dirigible balloons. In general, these sheds consist of a series of simple arch frames, similar in design to the usual armory roof in this country but of much lighter material because of the very light roofing. They are usually rectangular in plan, providing room for one airship with exit or entrance at either end, but some of the newer sheds are wide enough for two airships, side by side, and proposals have been made to build them in triangular or in starshape plan, so as to provide entrance in the direction best favored by the prevailing wind. To accomplish this latter end, at least one shed has been built, 443 x 85 feet in plan, mounted on a turntable so that it may be turned to meet any wind condition.

Constructional Progress at Regina

THE substantial character of the development that is going on at the Saskatchewan capital is shown in the illustrations reproduced herewith. The upper view is from a photograph of the architect's perspective of the new $30,000 residence for Mr. R. H. Read, and the lower view is from an elevation drawing of the Saskatchewan Co-Operative Elevator Company's building, which is estimated to cost $75,000. The Read residence is distinctive architecturally, but not from the standpoint of its construction and equipment, for of late years there has been a notable improvement in the character of the better-class dwellings erected at Regina. The Elevator Company's building is being erected by a firm which is in reality a farmer's organization, backed by the Provincial Government. Up to the present time quarters have been occupied in one of the large buildings in Regina, but the staff has increased so rapidly and so many new grain elevators have been erected that it has become imperative to build an up-to-date office building. This is an important step forward in the farmer's co-operative movement in Saskatchewan.

In using coloring matter with mortar or concrete, the color should always be mixed dry with cement, before any sand or water is added.



Saskatchewan Co-Operative Elevator Company's proposed new building at Regina.

MAINLY CONSTRUCTIONAL

EAST and WEST — FROM COAST to COAST

EASTERN CANADA

A subway, estimated to cost $190,000, is to be built under the C. P. R. tracks at Park Avenue, Montreal. Tenders will be called shortly.

The Canadian Hart Accumulator Company, Limited, has been incorporated with a capital of $300,000. The head office will be at St. John's, Quebec.

For June the Montreal building permits totalled $2,278,424, a decline of $334,828 as compared with June, 1913, although the permits issued increased 105. During the six months there was a falling off of $1,420,376 in the value of the permits issued.

The town of Alberton, N.B., have just awarded a contract to the Canadian Fairbanks-Morse Company, Limited, St. John, N.B., for a complete electric light outfit, consisting of dynamo, switchboard and the necessary transmission material for their new town lighting system. The dynamo will be driven by water power.

From Quebec comes the report that the improvements to the St. Charles River which are being carried out by Messrs. Quinlan & Robertson are making rapid progress. The work consists of the construction of a large dam and two locks. Two cofferdams have been completed, while the construction of a third is under way.

A stone crusher plant, estimated to cost $100,000, is to be erected at Rigaud, Que., by the Rigaud Granite Company, Montreal. Tenders are about to be invited for cars, electric motors and general machinery, and also for the building. The cost is inclusive of the building and machinery. Messrs. Poullin and Poirier, of New York, are the architects.

Toronto's building permits are making an excellent showing this year. For the six months ending June 30, the total was $13,476,140, as compared with $13,584,725 for the corresponding period last year. Last month's total was roughly three million dollars—a million more than for June, 1913. The number of permits issued this year is greatly in excess of last year.

Construction work has started on the big turning basin in the Fort William harbor, five miles from the mouth of the Kaministiquia River. Two clam-shell dredges are busily engaged in taking out loose earth and in about two weeks the large dipper dredges of the Great Lakes Dredging Company will also be in operation. The making of the turning basin is a hugh undertaking. Over thirty-five acres of solid earth will have to be removed before the basin is finished. It will take some two years to complete the work.

Reclamation work on the site of the new docks at West St. John, N.B., will be rushed rapidly towards completion during the balance of the summer. In order to meet the demand for increased area for tracks and sheds, a third clam digger has been ordered by the contractors and will be in operation within a few days. The new machine is of the latest design and is more powerful and speedier than the two now in use. Announcement is made that tenders have been called for the extension of the Negrotown Breakwater, an action which has been pressed upon the Dominion Government for some time.

It is understood that the Commission which is preparing plans for the city of Ottawa and district is providing that the roads leading into the city shall be 100 feet wide. Richmond Road, for example, which will be the main thoroughfare for all that part of the country into Ottawa, will be made this width. This is considered a wise precaution as the road will have to carry an immense amount of traffic in the future, and it is felt that provision should be made now when the widening of twenty-five feet on each side can be carried out at little expense. Other one-hundred-foot roads will be Pacific Street and the Merivale Road. All other roads of any importance will be made wide now in order to provide for future expansion of the Federal Capital.

Extensive enlargements of the power plants on the St. Mary's River at Sault Ste. Marie will be undertaken as the result of the decision of the International Joint Commission in the case of the Michigan Northern Power Company and the Algoma Steel Company. The former company has been granted a lease by the United States Secretary of War of 25,000 second feet of water, with provisions for additional water during high water periods. The Algoma Steel Company also has been granted additional water rights on the Canadian side of the river. The two companies applied to the International Joint Commission for approval of the plans for compensating works and for permission to construct them and divert the water into their power canals. The compensating works will consist of 16 Stoney sluice gates of about 52 feet span each, 12 of which will be built by the owners of the American company and four by the Canadian interests. In addition a dike will be constructed.

WESTERN CANADA

The erection of a 100-room hotel at Prince Rupert is proposed by Messrs. M. Albert and George A. Sweet.

The Pacific Great Eastern Railway is rushing construction on its line between Vancouver and Fort George, B.C. The Squamish section is 93 per cent. completed, and track has been laid to within 20 miles of the Pacific Coast terminal. Over 5,500 men are now engaged on the construction work.

Messrs. Stevens Brothers are the contractors for the First Presbyterian Church which is to be erected on Quadra Street, Victoria, at a cost of $130,000. The architectural style of the new building will be perpendicular Gothic. The plans were drawn by Mr. J. C. M. Keith. The new building will contain an auditorium with a seating capacity of thirteen hundred.

Tenders are being taken in connection with an important contract at Steveston, B.C., where a jetty, 7,100 feet long, is to be built at a cost of $150,000. The jetty is to be built of tiers of mattresses and rock. The bottom or apron mattress is to be 190 feet wide—95 feet on either side of the entire line of the jetty. The work is a Dominion Government undertaking.

There are between four hundred and five hundred men employed in the construction of the Government Interior Storage Grain Elevators, which are at present being constructed at Moose Jaw at a cost of $1,500,000. The elevators will have an initial capacity of 3,500,000 bushels and they are being constructed so that the capacity can be increased to 20,000,000 bushels, as necessity demands.

The Canadian Pacific Railway have completed their line from Expanse to Assiniboia for a distance of fourteen miles south of Expanse and the Moose Jaw City Council and the Board of Trade have waited on General Superintendent Taylor, of the Canadian Pacific Railway, asking to have the line continued through to Assiniboia at the earliest possible date. Only fourteen miles remain to be completed to make direct railway connection between Moose Jaw and Assiniboia. The towns on the Weyburn-Lethbridge line are also petitioning the company to construct the line at once, in order to give them communication with the main line of the Canadian Pacific Railway.

The Directors of the Burrard Inlet Tunnel & Bridge Company have taken another step forward looking to the award of a contract for the construction of the proposed Second Narrows bridge. Three firms are in the running for the work, and it has now been decided to call in an arbitrator. The tenders under consideration are as follows: Canadian Bridge Company, $1,846,000; Dominion Bridge Company, $1,916,000; C. A. P. Turner, $1,744,831. The Government, which has passed a subsidy of $400,000, has requested that no definite decision be made without first conferring with the authorities. The figure originally submitted by the Canadian Bridge Company was $2,076,218. This bid was modified, following the announcement that the Board would consider revised schemes, to $1,916,000, following by another reduction to $1,846,000. The Dominion Bridge Company quoted $2,287,791, then afterwards reducing its bid to $2,175,000 and $2,075,200, and finally revising the figures to $1,916,000. In the case of the Turner design, the original tender was $1,679,331, but in order to conform with certain technical changes suggested by the company's engineers, the bid was later augmented to $1,744,831.

We have to thank Mr. W. A. Littlejohn, City Clerk of Toronto, for a copy of his Municipal Hand Book, which is brimful of information appertaining to every department of the city's activities. This publication should be especially valuable for reference purposes.

Messrs. Laurie and Lamb, Montreal, have received an order from the Abitibi Pulp and Paper Company for four 500 brake-horse-power Bellis and Morcom engines, to drive their paper machines by rope drive. The Alberta Government have also ordered a 180 brake-horse-power Bellis and Morcom engine, to be installed at the Ponoka Asylum.

A glossary of road terms, compiled by H. Percy Boulnois, M. Inst. C. E., and published in serial form in this journal in November and December last, has been issued in book form by the St. Bride's Press, Limited, London, Eng., publishers of The Surveyor, the paper in which the glossary first appeared. There has long been a need for a reliable reference of this kind and the book should be found invaluable by all identified with road construction. The price of the glossary is 2s. net.

The total production of paving brick and paving blocks in Canada in 1912 is returned at 4,579,500, or an average value per thousand of $18.08, as compared with a production of 5,220,400, valued at $79,444, or an average value of $15.22 per thousand in 1911. This paving brick is made chiefly at West Toronto, Ontario, from shale obtained from the banks of the Humber River, although during 1912 a small production was reported at Pender Island, near Vancouver, B.C. The annual production for a number of years has varied from three millions to over five millions a season, and the output is said to claim a market chiefly in Toronto. According to recent returns, about 54 per cent of the production of sewer pipe in 1912 was made in Ontario.

Hydro-Electric Development at Eugenia Falls

In the Contract Record for June 24, announcement was made concerning the award of contracts in connection with the Eugenia Falls hydro-electric development of the Hydro-Electric Power Commission of Ontario. The following detailed particulars concerning the work are of interest:—The development is located on the Beaver River in the counties of Simcoe, Grey and Bruce, about forty miles from Owen Sound, Ont. The plant will be built to take care of the peak load on the transmission system of the Hydro-electric Commission and also to distribute power directly to Owen Sound and surrounding points. Power capacity available for the minimum year of precipitation on record is 3200 h.p.-hr. The commercial capacity, however, will be from 6,000 to 8,000 h.p., according to load factor. The available gross head is 550 ft., and the minimum operating head 510 ft. To increase the output of the station there will be a storage reservoir of 14,000 acre-feet capacity, sufficient to regulate the run-off from the watershed, which is 76 square miles. The dam, which will be 1,955 feet long, with a 105-ft. spillway, will have earth-fill abutments, with puddle cores, aggregating 700 feet. The crest of the spillway is 45 ft. above the foundation, while the dam crest is 5 ft. higher. Originally an earthen dam with a solid concrete spillway was contemplated, but after some months of study an Ambursen dam was determined upon and the contract awarded to the Ambursen Company. The plant will have a short diversion canal, with an intake gate structure of concrete and a 46-in. wood-stave pipe line 3,300 ft. long. At the head of the penstock, which is 50 in. in diameter and 1,500 ft. long, there will be a differential surge tank 100 ft. high. The two generating units will have 2,180 h.p., single runner, Francis turbines running at 900 r.p.m.

The plant is designed and its construction will be supervised by the hydraulic department of the Hydro-electric Power Commission of Ontario under the direction of F. A. Gaby, chief engineer. H. G. Acres is the hydraulic engineer.

Montreal Builders' Exchange

With a view to improving the financial standing of the Montreal Builders' Exchange, the members have decided on an adjustment of the fees. There will be three classes of membership—individual, with a fee of $30; corporate, $20 per capita; and associate, $20, the latter having been increased by $5 per annum. Corporate members are those who are affiliated through their trade organizations, and have all the privileges of individual membership with the exception of the right to vote. This, however, can be obtained by the payment of an extra $10, which places a member on an equal footing with individual members. The change will make no difference in the elective right of the representative of the trade organization on the executive. The fees can be paid in equal half-yearly instalments on July 1st and January 1st instead of making the full payment on the latter date, as at present. Fees will commence at either of the dates named, and there will be no more pro rata fees for those joining between the dates mentioned. The members also gave the executive authority to make an assessment fee, if needed, the basis being a percentage of the annual fee, but this is not to exceed 25 per cent. of the fee during any one year.

Personal Mention

Mr. D. H. Mapes, who recently succeeded Mr. Ellingwood as Superintendent of the Building Construction Department of the C. P. R., is an American by birth, having been born in Munroe, Orange County, N.Y., in 1869. He has been identified with the constructional business throughout his career and has worked his way up from a bricklayer apprentice to his present position. Mr. Mapes has been in entire charge of many fine buildings scattered throughout the New England, New York, and Eastern states. After his apprenticeship he went into the building business with his father in Brooklyn, afterwards organizing the Mapes-Reeve Construction Company, New York. Following this he was superintendent of the Sturgis and Hill Company, New York, and at a later date vice-president of the John V. Schaefer Company, New York. It will thus be seen that he has had a wide experience in the contracting and building lines. He joined the Canadian Pacific in July, 1912, as assistant to Mr. Ellingwood, and when that gentleman resigned was made chief of the department. While in New York, Mr. Mapes was Chairman of the Executive Committee of the Mason Builders' Association, and during the year 1912 was President of the New York State Association of Builders.

Mr. D. H. Mapes, Superintendent of Building Construction, C.P.R.

A Noted British Engineer

Sir Alexander Binnie, consulting engineer, whose advice has been sought upon a number of important municipal enterprises in this country, is the subject of an interesting sketch in the "Civic Engineer's Who's Who," reviewed briefly in another column. Sir Alexander, who is a Londoner bred and born, was engaged early in life on railway work, after which he served for six years in the Indian Public Works Department. For fifteen years he held the position of Water Engineer for the city of Bradford, and during his tenure of that office constructed several large reservoirs, one with an embankment one hundred and twenty-five feet high, at a total cost of some five million dollars; also he laid out for the city an entirely new scheme of waterworks. From 1890 to 1902 he was Chief Engineer of the London County Council and had under his charge the whole of the main drainage of London, including the completion of the sewage-disposal works at Barking and Crossness; and constructed the Barking Road Bridge over the River Lea, the new Highgate Archway, the tunnels under the Thames at Blackwell and Greenwich, and a sewer tunnel under the River Lea. He was continually engaged on the subject of London water supply, appearing on behalf of the Council before various Parliamentary Committees and Royal Commissions; and he prepared the necessary plans and sections for a new water-supply from the River Wye, estimated to cost some ninety million dollars. He is a past-President of both the Institution of Civil Engineers and the Institution of Municipal and County Engineers, a Fellow of the Geological Society, a Fellow of the Meterological Society, and a Member of the Royal Institution. As the author of many valuable professional works he has gained considerable distinction.

Mr. Robert Mitchell has been appointed Building Commissioner of Edmonton, Alberta.

Notes

Mr. Alex. Stewart, assistant chief engineer of the Great Northern Railway, whose death took place at Seattle recently, was a familiar figure in British Columbia. He erected the masonry work at False Creek and the Burrard Inlet dock, and other development work carried out by the Great Northern Railway in Vancouver was done under his supervision.

The danger of sewer gases was illustrated last week at Toronto in the death of Robert Strathearn, an engineer in the employ of the Works Department. The engineer entered the sewer for the purpose of securing levels and proceeded for a distance of about 150 feet, when he was overcome and died before help came. It was the greater part of an hour before his body was recovered. The lives of two men who attempted to rescue him were seriously jeopardized

Mr. H. N. Lymburner, superintendent of Government buildings, Montreal, died suddenly at his home, on July 2. He was 35 years of age.

There has been considerable labor unrest in Montreal. Many carpenters went on strike demanding an advance in wages and an eight-hour day. Prolonged negotiations with the General Contractors Association followed, the result being a concession of 2½c an hour, to 45c, with a nine-hour day. The bricklayers and masons, too, wanted more pay, a 5c an hour rise to 60c an hour, with eight hours a day. The General Contractors' Association also conducted the negotiations. Tentative terms have been arranged under which the men will continue work on the old terms for one year, with an advance of 5c the following year. A nine-hour day is to obtain in the summer and seven or eight hours in the winter.

A $3,500,000 office building is to be constructed at St. Paul, Minn., for the general offices of the Northern Pacific Railway and Great Northern Railway. It will be 290 feet by 232 feet, 13 storeys high with a basement and sub-basement. The building will be of steel frame construction with combination tile and reinforced concrete floor slabs. The exterior finish will be stone for the two lower storeys and brick and terra cotta for the remiander.

Visitors to the Canadian National Exhibition this year will have an opportunity of witnessing hydro-aeroplane flights. Arrangements have been made whereby W. A. Dean will fly his machine daily, starting from the lake and circling over the Exhibition Grounds. These flights will be given at various intervals during the afternoon, but one will take place at the fixed hour of six o'clock every day.

Ten o'clock on Tuesday morning each week is the latest possible hour at which tender advertisements can be received for the issue of the Contract Record published the following day.

An Expeditious Contract

Among the latest improvements to the Chateau Frontenac, Quebec, is a summer cafe, constructed to replace awnings and to afford visitors protection from the sun and also from unfavorable weather conditions. The doors enclosing the cafe have been specially designed to admit of their being easily and quickly closed in case of a sudden change in the weather, or of a storm, to which the city is subject.

The contract was completed in a very short time. The contracts were not let until April 15 and the cafe was completed and in use on June 1, a period of about six weeks The chief features are the ornamental cast iron columns supporting the roof and the steel glazed doors or sashes closing the space between them. The latter give the maximum amount of light combined with ample strength, a combination impossible had wooden doors been used. The light latticed arches and neat balustrade relieve the monotony of repetition, as do the cast iron urns on the roof breaking the severe lines of the cornices.

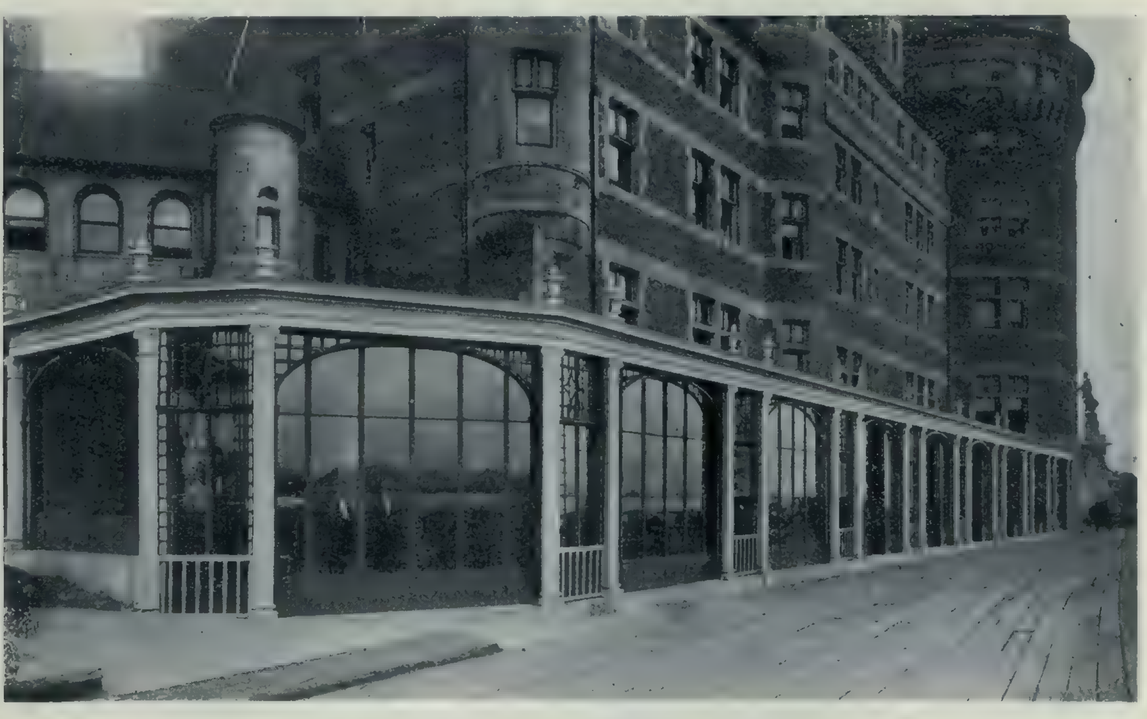
The combined weight of the cast iron columns and urns is nearly ten tons. These were delivered on the job inside of two weeks from the time patterns were given to the foundry. Considering the nature of the work this is an unusually short time.

The steel doors, specially designed for this building, operate on the accordian principle and consist of combined sliding and swinging doors, operating, in the large openings, in sets of three in each direction. They are hung on overhead carriers concealed in the cornice and having roller guides in the slotted sill, which is set flush with the cement floor. In the construction of the doors, the stiles, rails, base, etc., are made from solid rolled steel sections. They were carefully cut, coped, mitred and drilled from templates, with all intersections milled to produce perfect joints and ensure the uniformity of the entire number. The joints were then welded by means of the oxy-acetylene process of autogenous welding, which produces a very strong yet invisible connection, making in fact the two members thus actually one piece. There are 90 separate doors, each constructed of twenty-four members, there being approximately 2,200 joints to be welded.

The steel glazing beads were fastened by means of machine screws, and necessitated the drilling and tapping of holes for nearly 5,000 screws. This was accomplished by means of special tapping and drilling machines.

The contract, while not representing a large sum, is of interest from the point of the time in which it was executed and also from the immense amount of detail which it involved. It also shows that metal work can be promptly and well carried out in Canada. The architects were Barott, Blackader & Webster, of Montreal, and the general contractors, E. G. M. Cape, Limited, Montreal, the sub-contractors for the ornamental ironwork being Estey Brothers Company, Montreal.

A Canadian holding company owns the charter for a continuous line of railways in western Canada, covering a distance of approximately 1,250 miles. The line traverses a territory containing coal, timber, oil and various kinds of minerals and also a most productive wheat country. The company has made reconnaissance, route and location surveys costing about $150,000, and has also made accurate estimates of the cost of construction. Bonding powers and government grants considerably exceeding the estimated cost of construction are granted to the company by acts of the Dominion Parliament. The holding company owns several valuable tracts of coal, oil and timber lands and also a number of valuable terminal sites, situated in leading commercial centres. The company wishes to place the whole proposed line under construction immediately and is prepared to treat with capitalists or large contractors who will take the construction bonds at an agreed price and build and equip the said proposed lines according to the plans prepared by the company's engineers. Offers will only be entertained from capitalists or contractors of known standing. Correspondents are therefore required to give full particulars of their name and address in the first instance. Address first correspondence to Canadian Railway Builders, P. O. Box 601, Winnipeg.

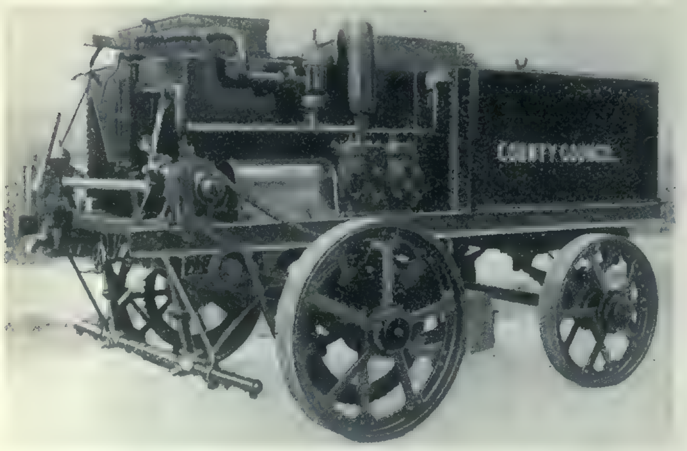


The Chateau Frontenac, Quebec, showing the new summer cafe.

Tar-Spraying Road Machinery

The surface treatment of roads under the development of The Taroads Syndicate, Limited (9 Victoria Street, London, S.W.; Eng.) is said to have become "a fine art." This company manufactures all classes of tarring machinery and contracts for the tar-spraying of roads and for the construction of bituminous bound roads. Their large tar-spraying machines are capable of treating as much as 20,000 yards super. of road a day. Roads treated for two or three years with these machines show a tar penetration of from two to three inches, and a complete, even distribution is assured. The success of Taroads Syndicate, Limited, has been phenomenal. Their operations have extended year by year until during the season of 1913 six contracts alone out of the large number undertaken represented the spraying of more than six and one-half million square yards, as compared with 344,000 square yards on the same six contracts in 1907. The machines have built up a wonderful reputation by virtue of their rapid dispatch, even distribution and assured penetration. One of the machines purchased by the London County Council is illustrated herewith.

No reference to Taroads Syndicate would be complete without mention of its founder, Sir Herbert B. Mackworth-Praed, Bart., to whom we referred in our issue of July 9th, 1913 (reporting the Third International Road Congress) as "one of the most active members of the General Committee of the London Road Congress." Sir Herbert Praed has accomplished as much for the good roads movement in England as any other single advocate of its claims. He has had a distinguished career and is an ex-member of the British House of Commons. By his initiative and enterprise in the field of good roads he has conferred lasting benefits upon the community. The conquest of the dust nuisance and the construction of roads which will meet the exacting requirements of modern traffic are not the least of his many attainments.



Taroads patented types "B" and "D" tar-spraying machines.

Oil Tractors vs. Auto Trucks

The automobile truck, under ordinary conditions, can make sixty miles a day over country roads, carrying six yards or nine tons of material at a trip. So doing it will make six trips on a ten-mile round trip haul, delivering 36 yards of material.

The 30-60 oil tractor, with a train of reversible engine wagons, will make two round trips on a ten-mile haul, carrying about 27 yards at a trip or 54 yards during the ten hours.

The automobile truck, with its tire construction, is especially adapted for use in the city on level pavements, while the tractor and wagon outfit is built for hard usage over rough roads and is less liable to break down under those conditions than the auto truck.

The cost of the wearing parts on the auto truck is about three times the cost of the wearing parts of the tractor and wagon outfit. The first cost of the automobile truck is much in excess of the cost of the oil tractor and wagon outfit, while the former will accomplish only about two-thirds of the work of the tractor and wagons.

A high speed truck constructed for use on smooth streets is entirely practicable in the city, but on the average country road different conditions are to be contended with and a practical hauling outfit must be constructed to meet those conditions. The contractor should consider carefully the type of equipment that will accomplish most for the money invested and that will cost the least to maintain.

Tiffin Motor Trucks, manufactured by the Tiffin Waggon Company, Tiffin, Ohio, are carefully described and well illustrated in a booklet just to hand. These trucks have earned a reputation for stability and for the absence of a single weak link in their entire construction. The Tiffin Company's long experience in building heavy duty vehicles has culminated in a motor truck that will stand no end of abuse, both in operating and loading. The trucks are built in three chassis models of fifteen hundred pounds; one ton and two tons. From all standpoints the company believe that they have evolved the most practical truck design of to-day. The trucks sustain the reputation which the firm have already made with their municipal and sanitary vehicles, sprinklers, automatic flushing machines, dumping wagons, and steel bucket street cleaning and garbage trucks.

The Marsh-Capron Manufacturing Company, Chicago, have issued in their catalogue of M-C Rail-Track Mixers a well-illustrated publication which will enable the contractor to select readily the size of mixer, kind of power, loading device, etc., best suited to his work. The company claim for their machine that it ensures "most mixing with least fixing"—a statement which would appear to be substantiated by a study of the constructional details which are illustrated to much advantage in the catalogue. The combined mixers and hoists shown in the catalogue have been developed to meet the requirements of contractors using concrete which has to be elevated to the upper floors of a building, bridge decks, or other structures of the kind.

A "Civic Engineer's Who's Who" has been compiled by the Editor of the London "Surveyor" and is published by the St. Bride's Press, Limited, Fleet Street, London, England. This interesting publication is a most valuable key to the personnel of the engineering profession in the Old Country and cannot fail to be well received by all whose work has identified them with their confreres in the "tight little island." The sketches are breezy and get away from the stereotyped character of most biographical material.

Bulletin B 7, just issued by the Herbert Morris Crane & Hoist Company, Limited, is devoted exclusively to the Morris type S 1 hand-operated overhead travelling crane, which is a very light crane, designed in various sizes up to 1½ ton. By making all the main parts of rolled-steel sections the weight of the crane itself has been kept very low, thus avoiding that disproportion between the dead weight and the live or useful weight which is so often a discouraging feature. The bulletin describes a large number of alternative constructions of the lifting gear, which are available for use under the varying conditions found in the many factories in which this type of crane can be used to advantage.

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Alphabetical Index of Advertisers
Page 16

Vol. 28 July 22, 1914 **No. 29**

Principal Contents

The Human Factor in Depreciation 917-8
Composition Flooring 918
By R. W. Page
Sherbrooke—Its Constructional and Industrial Development 919-23
A Town Planning Scheme: Its Effect on Housing and Architecture 923-8
By Raymond Unwin
System, as Applied to the Engineering Department.. 928-30
Design, Test, and Cost Data on New Municipal Refuse Incinerator at Regina 931-3
An Outline of Present-Day Practice in Water Filtration 934-6
Cement Joints for Sewer Pipe at Edmonton, Alta. .. 936-7
By J. M. Begg
Proposed Ocean and Railway Terminals at Halifax, N.S. 938-9
Selection and Use of Concreting Materials at the McKeesport Water Softening and Filtration Works. 939-40
Water Level Indicators and Recorders 940
Sewer Construction and Sewage Treatment 941
Another Aspect of Ventilation 941
Balcony Framing, McBride Theatre, Victoria, B.C. ... 942
Constructional News from the Saskatchewan Capital. 943-4
Personal Mention 944
Constructional and Industrial News 945-6

The Human Factor in Depreciation

THERE is one phase of municipal depreciation which has not received the attention it demands. In our recent Annual Number there appeared an admirable article, "Depreciation in Relation to Municipal Works," from the pen of Mr. R. O. Wynne-Roberts; but, as its title implied, it did not go beyond "works." The human element was not considered. The workman, the clerk and the professional man depreciate precisely as do the works for which they are responsible. Each of them is a "public utility," and all are important integers in municipal trading. Says Mr. Wynne-Roberts "municipal ownership entails great responsibilities, not only to the ratepayers and the patrons, but also to the investors. Efficiency means maintaining a department at a top-notch condition and the service at the same time rendered at a reasonable cost, whilst economy is often interpreted as a reduction of expenses to an excessive degree. Physical depreciation is influenced by these factors in a tangible measure, for if any plant is not maintained efficiently, then its value quickly falls and this in turn then affects the investors' interests and may also in time raise the price of the commodity produced or the service rendered." One might vary the statement by the substitution of the word "staff" for "plant," and it is obvious, too, that plant can be maintained efficiently by none but an efficient staff.

It is unfortunate that advanced civilization tends more and more to an utter disregard of the individual. He becomes merely a bolt or a nut in a complicated piece of machinery and may be replaced at will. His demission may cause a temporary stoppage or even a breakdown, but he is soon replaced and the machine goes on as well as before. There is a popular fallacy to the effect that an individual costs nothing. A horse or a cart represents a certain definite capital outlay, and if the one is injured or dies or the other is damaged in any way cash is necessary for replacement. Hence the necessity of a depreciation fund. But the reasoning is false. The expense of the ordinary individual—the worker, that is, of every grade—amounts to a goodly sum. For many years he has to be housed, clothed and fed without return, and the cost of this must fall ultimately upon the workers of the nation. "Who are you working for now?" a man once asked another, and the reply sums the whole matter up. "Who am I working for? Why, the same people—the wife and kids." A man must be paid at least as far as his absolute needs, and those needs include the maintenance and upbringing of his "kids." Hence he requires a proportionately fuller reward for his labours, and the nation has ultimately to back the bill for this. Even a millionaire's child depends for its existence upon the workers, although maybe it is the workers of all nations that contribute in amounts proportionate to the father's investments.

Let it be conceded then that the individual is as entitled to participate in a depreciation fund as is a sewage-pump or a dynamo. The whole time that the pump or the dynamo is at work a certain sum is being laid aside for its renewal when scrapping day arrives. In the case of the individual—and it is to be noted that in using the word "worker" we have used it in its very broadest sense—no such provision has been made. He is relegated to the scrap heap without a thought for his declining years, and a younger man takes his place. But without the older man the younger would not have been there. The older man absolutely provides the new machinery, in full working order. Emerson said: "The true test of civilization is not the census, nor the size of cities, nor the crops —no, but the kind of man the country turns out"; and it is the older man that is responsible for the "turning out" (for good or for evil of the younger). Confining our remarks as we have to the municipal aspect of the question, the men whose life-work consists largely of training the younger generation and fitting it to replace them, when their faculties (physical or mental as the case may be) are declining, deserve well at the hands of their country. The wages or salaries paid do not leave much as a provision for old age. As has been said, it is the older generation that provides the new, and it is entitled to share in a full depreciation fund. A pump becomes useless, and a sum sufficient to furnish another is drawn from the fund. When a man becomes useless, he supplies his successor—and draws nothing. The agitation in the old country for the superannuation of municipal officials of all grades is merely a demand for the provision of a depreciation fund to be utilized for the benefit of the individual.

Composition Flooring

By R. W. Page

COMPOSITION flooring is no longer an experiment. It has "made good" and is so widely specified and used to-day that there is no question whatever in the minds of those who followed the progress of this material since its introduction abroad and in this country that it is destined to fill a definite and no insignificant field in the building industry.

The architect or engineer who has had no experience in the use of composition material, and who may contemplate specifying it for some project he has in hand, should bear in mind four factors which largely determine a successful issue. These are: Selection of material to be used; provision for adequate foundation; use of skilled and experienced labor; protection and after care of the finished work.

To refer to these points briefly:

An intelligent selection of the flooring material. Owing to the fact that manufacturers in this country hold their various formulae as trade secrets, the architect is unable to specify the precise formula for the make up of the material as he does in the case of Portland cement. When we take into consideration the fact that oxychloride cement used in all composition flooring is capable of carrying other ingredients up to 20 times the weight of the cement, we can readily see what a vast variation there may be in composition flooring, not only with respect to the number of ingredients added but also in the relative properties secured. It is quite possible, and indeed very likely, that no two floorings of two different manufacturers are essentially alike. For these reasons the careful architect or engineer will not specify merely "composition flooring." He will name only those manufacturers whose material he has thoroughly investigated and this investigation will include the inspection of work installed for some length of time so that he may see for himself just how the material will stand up under service.

Under no circumstances should the architect or engineer make his selection solely from samples submitted. All samples look very much alike. Often the impractical mixture will make up into a better looking sample than the efficient material for the simple reason it is often easier to trowel-finish such a mixture to a good even surface.

An adequate foundation should be provided for in the general specifications: A large percentage of difficulties encountered in the past has been due to the inadequate foundation. I refer to concrete foundation as wood foundation presents no great difficulty.

The concrete foundation must be of sufficient richness and under no consideration should it contain lime. Buckling or coming away from the foundation is almost always due to one or the other of these causes. Most manufacturers provide printed foundation sheets giving the proper mixture of the concrete fill and methods of its installation.

Skilled, experienced workmanship essential: Composition flooring requires radically different handling and trowelling from that given Portland or other cements. It is utterly impossible to take a workman inexperienced in the work of this material, from either a cement workers' union or a plasterers' union, and expect him to turn out a satisfactory piece of work.

Such a man would not become proficient in this line without many days of actual experience in working with this material. For this reason it is not advisable to buy the material in bulk from any particular manufacturer and plan to install it by local mechanics. Expert workmanship is of the greatest importance owing to the fact that the color appearance of the finished flooring is dependent largely upon the time and manner of the final trowelling.

Protection and after care of finished work: Owing to the liability of damage from other mechanics (composition flooring is far more liable to such damage when it has been newly installed than will be the case after it has reached its maximum hardness) this material should be practically the last thing installed in a building. In so far as it may be possible the plastering should be done, the trim set, the glazing in place, the painting done and all fixtures installed.

Composition flooring should receive the same care to prevent damage caused by other contractors that is exercised in the case of finished wood flooring. Many an excellent piece of work has been permanently marred by carelessness in this regard. Most manufacturers will leave their work well covered by heavy paper, sawdust or both.

The after-care of this material is of importance. Frequent washing and an occasional oiling will serve to keep a floor in perfect condition and with this care it has been repeatedly demonstrated that composition flooring improves in appearance as it ages under service.

A reinforced concrete pontoon, for a landing stage for ferry service, has recently been put into use in the Harbor of Sydney, Australia. The pontoon is 100 ft. long, 43 ft. wide at one end and 68 ft. at the other, 7 ft. 9 in. deep, with a 32-in. freeboard. The bottom is flat, and the sides and ends are sloped to an angle of 70 deg. Special attention was given to the design of the reinforcement, with a view to enable the construction to withstand the excessive strains likely to occur should vessels be berthing at each side of the pontoon at the same moment. In the construction of the top and bottom of the pontoon, allowance has been made for a live load of 150 tons, which will be distributed over the center length between the posts. The whole structure is divided into 48 water-tight compartments by solid reinforced-concrete walls. It weighs about 650 tons.

View of the city of Sherbrooke from the east.

SHERBROOKE

The Approaching Mecca of the Union of Canadian Municipalities—
A City of Notable Constructional and Industrial Attainment—
A City of Manufacturing Facilities, Enterprise and Opportunity

THE city of Sherbrooke, Que., which has been called "the Queen of the Eastern Townships," was founded nearly a century ago by Sir John Cope Sherbrooke, who, in 1816, visited the place, then only a small hamlet with some half a dozen log houses. The halmet was named after the Governor.

Time passed. A court-house was built, churches appeared on the hilltops, public biuldings were erected, seats of learning were founded, railways were constructed and banks were established—and, finally, in 1875, Sherbrooke was incorporated as a city. From that time Sherbrooke began to acquire a position of industrial importance which she has steadily maintained and improved.

An interesting feature of Sherbrooke's growth in recent years is the success with which it has carried out the idea of municipal ownership of public utilities. The first of these utilities to be taken over by the city was the waterworks, in 1897. The waterworks system has been a complete success from the beginning, The citizens are receiving first-class service at low rates, the city treasury is swelled each year by a neat profit and fire protection is properly looked after.

Improvements to Waterworks During Past Year

Last year extensive improvements were made to the water system. The new pumping station was built. This contains four power pumps and waterwheels with a pumping capacity of 8,000,000 gallons a day. It is estimated that this will meet the requirements of Sherbrooke until it has doubled in size. The cost of the new pumping station was $60,000. A new reservoir has also been provided. The water is forced to the reservoir over a distance of three miles through 20-in. and 24-in. mains. The elevation of the reservoir above the pumping station is 190 feet. The elevation above the commercial centre is 330 feet. This affords a pressure of 125 lbs. A stream of water from the fire hose can be sent far over the highest building. Twenty-two miles of pipe are required for the distribution system.

Power, Light and Gas

The most interesting feature of Sherbrooke's municipal ownership is the progress of the electric light and power plants. It was in 1908 that the city took over the management of the electric department. The story of its success may be set forth briefly as follows:—1908, one hydro-electric generating station; 1913, two larger hydro-electric generating stations; 1908, 2,218 customers for lighting, power or gas; 1913, 4,500 customers for lighting, power or gas; 1908, 1,398 h.p. highest peak load demand; 1913, 3,500 h.p. highest peak load demand; 1908, 94 arc lamps and 65 incandescents for street lighting; 1913, no arc lamps,

Plant of the Paton Woollen Mills—the largest of its kind in the Dominion.

A part view of the Canadian Ingersoll Rand Company's plant at Sherbrooke.

Penstock and Buildings of the Sherbrooke Railway & Power Company.

The 54th. Regiment Armory, Sherbrooke.

"The power behind Sherbrooke." Drop-off No. 1.

2,400 60 c.p. tungsten lamps. 1908—Prices: light 10 cents kw. hour; power $25 to $45. 1913—lighting, .054 kw. hour; heating, .02 kw. hour; power, .0075 kw. hour ($16.70 per annum). 1908—Assets $351,365.94; liabilities $252,713; surplus $98,652.26. 1913—Assets $613,530.97; liabilities $410,124.05; surplus $203,406.92. 1908—Gross revenue $72,214.62; 1913—gross revenue $120,184.38.

The remarkable point about these figures is that while the prices of light and power have been cut down the profits have steadily grown. The plants are kept up to the highest standard. A reserve for unseen depreciation has been provided to the extent of $69,098. From the very start the department has been self-supporting. No money out of ordinary city tax collections has been invested in the department. The city now owns six powers, four developed and two undeveloped. The amount of power developed is 6,000 h.p.; undeveloped 5,000 h.p. This year the only wooden dam remaining will be replaced by concrete. The direct income resulting from the ownership of the light and power department is easily measured, but the greater indirect benefit derived from the advantage of being able to offer the lowest rates to manufacturers can hardly be estimated.

The organization of the Sherbrooke Railway and Power Company and the development which it has promoted during the last three years have meant a great deal to the city of Sherbrooke. The capitalization of the company was placed at $1,500,000 five per cent. thirty-year bonds, of which $700,000 were issued and $1,500,000 ordinary stock of which $700,000 was also issued.

The new dam is 300 feet long and is built across a rock gorge. About 3,000 cubic yards of concrete have been used in its construction. It was built in three sections—a large spillway section in the centre, and bulkhead and stoplog sections on the side. A steel plate thimble, 13 feet in diameter, is let into the bulkhead section to convey the water into the penstock. Through this the water is carried to the new powerhouse, 650 feet below, thus obtaining a working head of 63 feet. Of the 3,300 h.p. thus developed, about 500 h.p. is required to operate the street railway and the remaining 2,800 h.p. is available for industrial purposes.

The Sherbrooke Railway & Power Company's dam.

The organization was financed and put through by McCuaig Bros. & Company, of Montreal. The advantage of having this organization so closely identified with Sherbrooke is apparent becaues of its ability to interest capital in local industrial pursuits.

The opportune location of the city has always marked it as a distributing centre. Montreal, Ontario and the West may be reached either by the

"The power behind Sherbrooke," Drop-off No. 2.

Grand Trunk or by the Canadian Pacific. Halifax and St. John, N.B., may be reached via either the Canadian Pacific or over the Quebec Central via Harlaka Junction and the Intercolonial Railway. The Grand Trunk Pacific connecting with the Quebec Central offers another competing route for the lower provinces. The port of Quebec is reached directly over the Quebec Central or the Grand Trunk. Direct communication to the large centres of the New England States and to New York City is provided by the Grand Trunk and Boston & Maine Railways. Competition of transportation lines and the accessibility of the city have been great drawing-cards in inducing industries to establish in Sherbrooke.

The Bank of Montreal, Sherbrooke.

That Sherbrooke is sound as an industrial centre is evidenced by the success of its present industries. During the last few years it has established itself as an iron and metal-working centre. Among the industries of this nature are the Jenckes Machine Company, the Canadian Ingersoll-Rand Company, the MacKinnon Holmes Company, the Sherbrooke Machinery Company, the Sherbrooke Iron Works Company and the Canadian Brakeshoe Company. All these concerns, some of them recent arrivals, have been growing steadily since their establishment.

Some of these industries are unique in the nature of their work. The Canadian Brakeshoe Company is the only industry in America welding steel by electricity in electric furnaces. The Canadian Ingersoll-Rand Company has the largest shops in Canada making compressed air machinery. Its steady growth can be seen from the fact that ten years ago it occupied a floor space of 21,560 square feet, while to-day it occupies 200,000 square feet and is paying out wages to the extent of $275,000 a year compared with $45,000 ten years ago. There are upwards of two thousand men employed in the Sherbrooke metal-working industries.

Although Sherbrooke is fast becoming an important metal-working centre, its industries are not limited to this class. Its first large industry was the Paton Woollen Mills, which is still the largest plant of its kind in Canada.

The Canadian Connecticut Cotton Mills has commenced operations in Sherbrooke this summer. This is the only company in Canada specializing in the manufacture of tire duck. The main building measures 112 feet x 236 feet, two and three storeys; the picker building is 60 x 61 ft., three storeys; the boiler house 52 x 40 ft., one storey, and the storehouse 100 x 100 ft. one storey. The height of the chimney is 80 feet. The building is the most modern factory construction, well-lighted and provided with sprinkler system. The company own six acres and is already talking about expansion.

The Panther Rubber Company have also begun operations in Sherbrooke and the Whiting Davis Company, manufacturers of jewelry, have opened a plant. These last-named industries are branches of New England establishments.

Constructional Work to be Undertaken During Summer

In spite of the general depression, a good deal of construction is now going on in Sherbrooke. The

R. C. Seminary and College at Sherbrooke.

28(29) 1914

J. H. Hamilton Shoe Company is erecting a modern shoe factory and the Sherbrooke Machinery Company is doubling its capacity. The North Ward High School is being completely renovated and extended. The Bell Telephone Company propose erecting a fine new building. A new theatre and two new stores and office buildings are being completed in the commercial district.

The growth of the city during the last five years compelled the council to give attention to the inadequacy of the sewerage system, accordingly Mr. Hilder Daw, the Montreal consulting engineer, was instructed to prepare plans of a system of sewerage which would suffice for fifty years. The plans are now well advanced. A suitable site has been provided for purification purposes. The trunk main skirts the Magog and St. Francis rivers.

The program of road work this year includes three miles of penetration pavement to be constructed as follows: 12 ins. rubble stone; 4 ins. of 3-in. macadam stone treated with 1 1/5 gallons Tarvia X; 2 inches of 1½-in. stone treated with 1 gallon Tarvia X with a top dressing of ⅜-in. crushed stone.

The Eastern Townships Exhibition is held in Sherbrooke every year and attracts thousands of visitors to the city.

A Town Planning Scheme: Its Effect on Housing and Architecture

(By Raymond Unwin)

THE essential parts of a town planning scheme were considered in detail in an interesting paper read by Mr. Raymond Unwin at a recent meeting of the Institution of Municipal and County Engineers, at Dunfermline, Scotland. Mr. Unwin is well-known as one of the leading town planning experts of the old country, and although his observations will be found somewhat "English" in regard to the more superficial questions of local practice, the underlying principles of his discussion contain much that should be found suggestive by all identified with civic improvement in Canada. The paper is slightly abstracted, but it contains so much solid matter that any promiscuous cutting would be out of place. We therefore present the paper in extenso.

To quote Mr. Unwin:

A town planning scheme consists of two parts. There is first a plan, and second the text of the scheme, which includes a series of regulations of the nature of by-laws covering a very wide range of subjects, which may be independent of the plan, or may consist of interpretations of the plan, or regulations which take effect in particular areas defined by the plan. The effect of the scheme therefore depends on the constructive meaning of the two parts read together, and it will only to a limited extent be possible to deal with the parts separately. So far as it is possible, however, it may be well to take the plan first.

There are certain considerations in connection with it which appeal strongly to the architect, whether he is considering the effect in architecture as a whole, or the effect on the domestic branch which we have summed up under the word "housing." The architect's special point of view may perhaps be stated by saying that he looks upon the scheme as a design; as something thought out as a whole, aiming to produce some definite total effect which will depend on the relation and proportion between the different parts. A design must not, however, be taken to mean merely a pretty picture on the paper. Many natural features of the site, many existing conditions, such as the position of railways, waterways, roads, or buildings, will determine the planning, and will very often prevent that symmetry and balance over large areas of ground which would produce the pretty paper pattern. The town plan is not made primarily to be beautiful, but to provide for the convenient and efficient arrangement of all the different component parts which go to make up the modern city. When the architect is asked to design some decorative feature he is right in concentrating his attention almost exclusively on the creation of a beautiful object; but when he is asked to design a building he must first consider the purposes for which the building is required, its efficiency for these purposes, and its convenience for those who are to occupy it. These considerations will determine the main disposition of the parts, their relation to one another, and the size and detail accommodation required in each; but it is the function of the architect to find a solution of these dispositions, relations, and sizes that will not only give the utmost convenience and efficiency, but in addition will create a beautiful building by the proper adjustment of the different relations, and by the harmonious proportioning of the parts. It is quite possible to create an efficient and convenient building which will be devoid alike of interest and beauty; such a building is not architecture. It is also possible to design a building of considerable superficial beauty of proportion and interest of design which may, nevertheless, be most inefficient for its purpose and inconvenient for its occupants; such a building is equally not architecture in its true sense. It is when the utilitarian objects are efficiently satisfied by a building of beautiful proportions and interesting detail that we have genuine architecture produced.

Exactly the same is true of town planning. In the disposition of the areas, the arrangement and alignment of the roads, the position allotted to the main buildings, the sizes of the different open spaces, and the widths of the highways, the plan may be such as to provide efficiently for the needs of the town, and yet may not contain the elements of design, may lead to no beautiful grouping of the buildings, no distinction resulting from their placing, and no interest arising from the relative position and proportion of the different parts.

It is only when all the utilitarian considerations are fused into some consistent design by the exercise of an imagination specially trained to find beautiful forms by means of which to satisfy useful purposes that a really fine town plan is produced. This is the contribution which the architect, as architect, has to make. A few individual architects may know enough of engineering and surveying to handle the whole problem, just as some engineers and surveyors may have enough architectural feeling to confer that crowning quality of beautiful design on their schemes; but the knowledge required by these different professions, and the cumulative effect of their practice is so different, that usually it will be necessary for a successful result that representatives of the different professions should work together, so that the total contribution of skill may be higher than can ordinarily be expected from an individual who knows a little of each branch. But if this co-operation is to be effective, each party must have sufficient knowledge and appreciation of the importance of the other departments to give due weight to their representations. The engineer must not sacrifice main architectural matters for quite minor considerations of gradient or convenience; nor must the architect sacrifice the utility of roadways by piling them up on embankments in order to maintain some preconceived effect not suitable to the particular problem in hand. In the main it will be found that while the aims and purposes of the architect, the engineer, and the surveyor are different, they are not conflicting; and that a simple, definite scheme with wide, handsome roads and well-designed crossings and road junctions will be the best form in which to provide easy and convenient thoroughfares.

In considering the scheme of

Roads

it is important to remember the two main purposes for which they are required—to accommodate traffic and to afford frontages for buildings. Roads generally serve both these purposes, but their treatment depends largely on the relative importance of the two functions; those that are required to serve as main roadways for traffic should be planned primarily for the convenience of traffic, and their junctions should be considered from this point of view first. On the other hand, those roads, the traffic on which is mainly concerned with the buildings fronting upon them, should be considered primarily from the point of view of affording economical, serviceable, and therefore valuable building frontages. As far as possible such roads should either follow approximately the lines of the contours or should travel at right angles to those lines, so that the plane of the land, in whichever direction it may slope, may be nearly square with the building. Both the satisfactory placing of the building on the ground and the convenient treatment of the garden depend considerably upon this. Not only is the importance of traffic secondary in these roads, but it is even desirable that they should not be planned so as to afford short cuts for main lines of traffic. The only way in which it is possible, without great total cost, to secure adequate width for main arterial roads, is to design the minor roads so that they cannot become trafficways; the actual width of the carriageways and footways in these may then safely be reduced to a minimum, and the saving in land and cost thus effected can be set off against the extra width and cost of the main traffic highways. This does not mean, of course, that the width between the building lines on minor roads should be reduced, nor even that the width dedicated to the roadway should always be reduced. There will be cases in which it may be desirable either to provide space for the decoration of the roadways with grass margins, shrubberies, or trees, or to provide space for possible future widening of footways or carriageways, where, owing to the planning of the roads, an increase of traffic seems possible.

It is hardly necessary to emphasize the degree to which the health and attractiveness of dwelling-houses depend on the planning of the roads. The spacing of the roads influences the frontage given to the houses, and the area of open ground available to provide air, light, and outlook for the windows. Their adjustment to the nature of the slopes of the ground will have a marked effect on the cost of roadway per house; careful planning will preserve the residential roads from through traffic, thus reducing both noise, dust, and danger, and will, moreover, keep open many attractive views of open spaces and distant objects of interest or beauty. The orderly arrangement of the houses themselves and the decoration of the streets with trees and shrubs will add enormously to the pleasantness of the dwellings; and at the same time a good system of main trafficways, by adding to the facility for getting from place to place, will increase the efficiency of the people as industrial workers and add to their opportunities of enjoying social life and culture.

Some sacrifice of the building convenience may wisely be made on arterial roads; in order to increase their directness, or improve their gradients, we shall be justified in carrying out an extent of cutting and filling that would be unpardonable on a building road. Where there is a choice between cutting and filling, it may be taken as a general rule that filling is most objectionable in roads where dwelling-houses are to be erected, and cutting in roads for business premises. Dwelling-houses are much better built above the road than below it. On the other hand, business premises must be entered on a level with the road, and can usually employ a basement storey profitably; this means that when the road is in a cutting, heavy expense must be incurred in excavating the site, and sometimes also in sinking cellars still further below the level. The main consideration on the arterial roads, however, must be the traffic; and it is important to consider this in planning the scheme of minor roads. In order that their traffic should interrupt that on the main roads as little as possible, it should be collected by secondary roads, and delivered by them at not too frequent intervals into the main arteries. It should not be forgotten when planning that every needless junction or crossing on a main artery reduces its efficiency as a traffic carrier. Moreover, when arterial roads are broken into by too many minor roads, the facades of the buildings are apt to become ragged, to lack sufficient breadth and dignity; here as often we find the architectural considerations in harmony with the traffic convenience. On the other hand, in the minor residential roads, the variations which will give further adjustment of the roads to the site, and the limited vistas which will be produced by so planning the roads that, while they divide up the land conveniently, they do not form tempting short cuts, will help the architectural effect with the type of domestic building for which they are intended. The importance of so planning the roads and road junctions as to give at least a favourable opportunity for the beautiful grouping of the buildings must not be overlooked. A straight approach on an axial line to an important building, and the development of the whole of any civic or other centre composed of a group of public buildings on such an axial line, will be found to give a sense of order and dignity. Certain types of building are usually characterized by more handsome architectural treatment; it is desirable that the most should be made of these opportunities, and that these buildings should, as far as possible, be placed where they will confer distinction upon several street pictures, and serve as central features for architectural groupings from several points of view.

In most localities there are features connected with the history of the city's development in commerce, civilization, or culture, around which there cling the most cherished associations of the people, or which keep alive the memory of heroic citizens of the past. Underlying and infusing all the planning which we have been considering from utilitarian and aesthetic points of view, there must be a sympathetic appreciation of these higher elements of the individuality of the city, and an imaginative enthusiasm for their expression in the outward form of the town, if the result is to be a work of art of the higher order.

We must pass now from the town plan to

The Text of the Scheme

Here the architect's point of view is somewhat peculiar. He usually sympathizes with the aims of by-laws and building regulations, but is intensely irritated by their methods; and if town planning schemes are to work smoothly, the municipal authorities must try to understand this point of view.

The architect is delighted that adequate space about his buildings should be secured, but he is annoyed when that space is required to be exactly in one position, and of an exact dimension throughout the width. He would willingly support the municipal authorities if they would ask for two or three times as much average space about the buildings, if only he could be allowed some liberty to dispose this space as may best suit the circumstances of each individual case. He is in full sympathy with the local authorities when they require a certain minimum cubic space to be provided in a living room; but when he is required to reduce the size of a room by cutting off the angles to provide a minimum height to the springing of the ceiling, either wasting the space or providing cupboards that are not wanted, then he is tempted to put in dummy cupboards and remove them after the building is completed.

He is in agreement with the local authority which has sought to prevent the erection of stuffy and congested closes; but when he finds that he cannot erect a quadrangle of buildings without leaving gaps in each angle, or carrying the road right through to avoid a cul-de-sac, then by-laws are apt to become his bugbear, and the defeating of them one of his chief delights!

The town planning scheme is largely an extension of the field which may be covered by building regulations, but it is freed from many of the technical difficulties under which by-laws have been made by the local authorities in the past.

Strictly speaking, there are only comparatively few matters on which, previous to the Town Planning Act, by-laws could legally be made, and much ingenuity has been expended by the local authorities and the Local Government Board to make by-laws produce indirectly effects which they deemed desirable, but which they were not legally empowered to secure directly. One result has been that large sums of money have been wasted in making wide roads, because a by-law could not fix a minimum distance between the houses. There is only one way in which building regulations can be made to work satisfactorily, and that is for them to provide sufficiently generously for the requirements to enable a considerable amount of freedom to be left as to the particular method in which they are satisfied. If you secure a sufficiently ample provision of open space about buildings, you can disregard the exact position in relation to the individual building, and the exact distance at any point across a particular bit of open space. This is a very important consideration when framing regulations under the scheme for limiting the number of houses to the acre. It is in every way wise and practicable to reduce the average number of houses to the acre over a reasonable area to such an extent as will secure not only ample light and air space for the houses, but a sufficient proportion of garden ground in relation to the population to provide quite a considerable addition to the economic basis of the family, and sufficient recreation areas for both children and adults; but if this result is to be attained considerable elasticity must be secured. I find that with an average disposition of ten houses to the acre for a rectangular building plot measuring 10 acres there may be usually sixteen or seventeen houses on 1 acre in the corner. If the space is not rectangular, and should be bounded by roads meeting at an angle of 60 deg., there may be twenty houses to the acre on the corner; or, if the road should meet at a still more acute angle—say, 45 deg.—the number of houses to the acre may go up to twenty-four or twenty-five if the full use is made of the road frontage, and all the houses are of the smallest type. While, therefore, over the whole unit of 10 acres it is desirable to reduce the number to ten, twelve or fifteen to the acre, very great care must be taken not to cause a needless waste of road frontage at junctions by insisting on too low a maximum of houses on the individual acre, or on too arbitrary a method of measuring it. It will be seen that, if the acre at the corners were measured to include more of the back land instead of being made square, the lower maximum number of houses on the individual acre would be practicable without causing waste of road frontage. For this reason I think it is a good rule that the general limitation should be sufficiently drastic to secure plenty of open space, but that the particular limitation applying to the individual acre should be sufficiently generous not to cause unnecessary waste of road frontage. Further, if open space is secured generally by the limitation of the number of houses to the acre, any requirement as to the area of open space at the back of the building, or as to the proportion of an individual plot which may be covered by buildings, should leave the greatest possible elasticity in the laying out of buildings around corners.

It is not generally realized how difficult it is to stereotype the minor development of a plan for a large area without causing very serious waste. For example, if a town planner were to lay out the detail roads on 20 acres of land on a basis of ten houses to the acre, under the expectation that the average frontage per house would be 30 ft., he would have to secure a certain depth of plot and distance between his roads and provide 2,000 yds. of road frontage; but should the type of house eventually built be a narrow house having an actual building frontage of only 15 ft. or 16 ft., probably the average frontage of road required would not much exceed 20 ft.; but he would have laid out 666 yds. of frontage, or 333 yds. of roadway on these 20 acres more than was required, and the unfortunate person who had to develop the land would have wasted £1,333 if the roadway cost £4 per lineal yard. Now it is not possible to foresee exactly what type of house will be built in different places, and therefore elasticity in the number of minor roads, their arrangement and placing on a plan must be permitted if waste is to be avoided. On this account I am inclined to think that the best arrangement for limiting the

Number of Houses to the Acre

is to fix units of reasonable size, taking, as far as possible, areas that are defined on the town plan by main roads, railways, streams, or other definite features not likely to be changed. There should, then, in connection with each unit, be fixed a maximum average density for the whole of the unit, and a maximum density for any one acre within the unit.

But there is still one point to consider: Houses vary very much in size. If it is permissible to have a certain maximum number of large houses on an acre of land, is it not permissible to have a greater number if the houses are each only of one-half or two-thirds the size? In deciding this matter, we must consider the reasons for limiting the number of houses to the acre. These are mainly two: First, limitation aims at providing a sufficiency of open space about dwelling houses to secure an ample supply of the freshest of fresh air and full access for sunlight, both of which are necessary for health. So far, then, as this reason goes, it would seem to be important to take into account the size of the building in fixing the number to the acre, otherwise the larger the building the less would be the open space. There is, however, a second reason for limiting the number of houses—viz., to secure, on the average, to each family the use of a certain amount of ground for recreation, for the growth of garden produce (a matter of great economic importance), and for the preservation of the pleasantness, or, as it is called in the Act, "the amenity," of the area. For this purpose the amount of land required is rather a fixed quantity per family, and does not necessarily depend on the size of the house. The family living in the small house really needs as much land as the family living in the larger house; but it can hardly be contended that it needs more. So even here there is reason for making some difference, because with a given number of houses to the acre a small house, owing to the less area which it covers, will be left with a larger area for garden than the large house, and the utmost that can be said under this heading is that as much land is needed.

There is, however, another pressing reason for doing something to adjust the area of land to the size of the house, and this is the increasing ratio which the cost of the site bears to the cost of the house as that cost decreases. In a house costing £1,500, the cost of the site, including the cost of road making, will usually be no more than one-sixth of the value of the house; in the case of the £150 cottage, the value of the site will not uncommonly be found to represent one-quarter or even one-third of the value of the house. This means that, relatively, the smaller the house the greater is the expense of providing it with a site. If, then, we fix a given limit to the number of houses without reference to their size, we shall add still more to the relatively higher cost of site for smaller dwellings. This is not desirable, for already there is a strong inducement to the builder to build on each plot as big a house as possible, because the bigger house will carry a little more ground rent or site value than a small one, even for the same actual area of ground.

For all these reasons, therefore, it seems to me of importance that the number of houses to the acre should be limited by means of a schedule, which should fix the number in relation to the size of the house, and for the purpose of determining the size of the house one needs to take the effective size, and to eliminate accidental matters, such as the difference between a high-pitched roof or a low-pitched roof, or the difference between a house that has a large cubic space occupied by foundations and one that has a minimum of foundations. On the whole, therefore, I think the best plan is to fix the number according to the cubic contents of the building, measured to the outside of external walls, to the centre of party walls, and excluding from the measurements all unused space above the level of the highest ceilings and below the level of the ground floor of the building. The schedule would then be somewhat as follows, the actual numbers being adapted to suit the individual circumstances:—

Houses containing not more cubic ft. than	Maximum average to the acre	Maximum on any one acre
5,000	15	20
6,300	14	19
8,000	13	18
10,000	12	16
12,000	10	14
14,000 and over	8	12

The question of

The Building Line

in town planning schemes has considerable bearing upon the building of houses and the architectural effect of the streets, and it is not easy to frame regulations that will work satisfactorily in all cases. There are existing roads on which it may be desirable to fix a building line for the purpose of securing the possibility of road widening at some future date should the traffic on the road develop sufficiently to require it. A line that is fixed for this purpose must, if it is to be effective, apply to all buildings, and must not be subject to exceptions on corner sites, or for the purpose of giving a sense of enclosure to the street view at certain points. On the majority of roads that are mainly used for building purposes, and have only to accommodate local traffic, and on new roads laid out of ample width, the question of street widening beyond the limits of the street boundaries hardly arises. Here the building line is fixed for the purpose of providing adequate width between the rows of houses to secure light and air, and the amenity of the streets; for this last purpose it is desirable that there shall be some opportunity for varying the building line. In some schemes the minimum amount of set-back which could be accepted for any building is all that has been secured, leaving anything further entirely to the option of the builder; in other schemes an attempt has been made to secure a more generous depth of forecourt over the general frontage of the street, but at the same time to give opportunities both to bring forward certain limited lengths of frontage here and there, and also to bring forward, to some extent, the houses at the corner of two streets, so that the amount of road making which must be wasted at street corners may not be unduly increased. While it is certainly desirable in town planning schemes that there should be an opportunity for a settled building line more interesting than the simple continuous street line, it is obviously not desirable that houses should be dotted down along the road irregularly, just where each individual builder may think fit. For this reason, perhaps, the best solution of the building line difficulty is to require a minimum length of building frontage to be submitted as a definite scheme where the ordinary building line is to be departed from. Clauses to this effect are provided for in the Ruislip scheme.

Where the land slopes steeply it is not at all desirable that the buildings on each side should have to be an equal distance from the centre of the road; generally speaking, and where land in several ownerships has to be dealt with, the building lines may need to be set out equidistant from the centre of the road; but provision should be made in the scheme for cases where it is desirable that houses should be set much nearer the road on one side, generally where the ground is falling from the road. This may be compensated for by setting back the houses on the higher side of the road, the distance between the two building lines remaining the same.

Having secured ample space about buildings, perhaps the next most important point is to secure that adequate

Frontage

shall be provided for each house, and that long projecting wings shall not be permitted in such a way as to block proper access of light and air to the windows. There is in the Ruislip scheme a somewhat complicated clause dealing with this matter which secures an angle of light of 45 deg., but it does not prevent the window to a living room being placed at the end of a narrow space between two wings. A simple regulation requiring that all the living room windows should have a certain angle of light vertically and horizontally would, I think, be more effective, and more readily secure the desired result; such angles should not be less than 60 deg. This would allow of reasonable projections to buildings, but would prevent their undue extension in length, or their undue proximity to each other in the manner that is so objectionable in a very large number of buildings erected under the ordinary by-laws.

Where an attempt is made in a town planning scheme to fix the height of buildings, or to limit the number of storeys, care must be taken that this is not effected in such a rigid manner as to require on a sloping road the stepping down of every building. Provision should be made that a level roof may be carried over a group of four or six buildings, and the extra height of the lower buildings utilized for an additional storey.

In a similar way, one might go through many other individual regulations which aim at something which is desirable, and might point out how easily, if these regulations are looked at apart from the point of view of those who have to build under them, they may prevent many things which are quite harmless from being done, and may even entail the doing of much that is undesirable. For this reason it is most important in framing town planning schemes that the local authorities should enlist the co-operation and assistance of architects and builders. It is perhaps natural that the busy official of a local authority who is trying to put through a town planning scheme in the short spaces of time he can snatch from his other work should be somewhat impatient of criticism and suggestions; but he should remember that he looks at a regulation purely from one point of view, and that no regulation is good which only satisfies the point of view of the official. The Town Planning Act is so framed that any new regulation that is included in the scheme can be carefully adjusted to meet the

Needs of Exceptional Cases,

and to suit the varying circumstances of different districts, and even different areas within the same district. The framing of such regulations is by no means easy, because it is not only the effect of the particular regulation that has to be considered, but the constructive effect of two or three regulations taken together. For example, in the draft of one scheme it was provided that on certain roads houses should be set back 35 ft. from the boundary of the road, and it was also provided in another part of the scheme that no house in a certain area should be more than two storeys in height. Where land was sloping steeply, the result of setting back the houses 35 ft. would be that one storey would be below the road, and would be in effect a cellar; so that these two regulations, taken together, would mean that on certain sites houses could only be built having cellars and bedrooms, with no proper ground floor rooms at all. What we need is so to frame our regulations that they will effectively prevent anything that is detrimental to health or injurious to the amenites of the district, but will leave the utmost possible freedom for every builder to do anything that he may desire to do that is in itself harmless and unobjectionable.

So far we have been considering the regulations of a town planning scheme as affecting the placing of buildings and the distribution of space about them; but the town planning scheme affords an

Opportunity for Modifying By-laws

in England, or regulations made under the Burgh Police Acts in Scotland, and these are much needed. In England the by-laws were framed especially to prevent the evils springing from an overcrowded development of small houses packed together in long rows, without proper access, air space, or sanitary conditions. Such packing together of small houses produced certain dangers which had to be met by a fairly complex system of building regulations, aiming to secure protection from fire risks, sanitary conditions, and a certain standard of stability; but if once the overcrowding of these dwellings is prevented by a definite limitation of the number of buildings which may be placed upon an acre of ground, the whole character of development is changed; the relative importance of many matters must necessarily change also. For example, with endless rows of dwellings packed together closely, the risk of fire spreading from house to house over a large area may be sufficient to justify the by-law requiring parapet walls to be carried up through the roof between each pair of houses; but with the development which follows from the limitations of houses to the acre, such risk is greatly reduced, and the requirement ceases to be one on which it is desirable that the local authorities should insist, for not only can the cost of complying with it be spent to much greater advantage in other ways on the building, but it is in itself an ugly and inconvenient expedient, only justified by a very serious danger.

In Scotland the Burgh Police Acts have been largely framed with a view to meeting the difficulties arising from the prevalence of many-storied tenement dwellings. With a limitation of the number of dwellings on the acre, there can be no doubt that this system of housing families one above the other will give place to that of housing them each in their own house, standing on its own plot. It is necessary, therefore, that all the regulations embodied in the Burgh Police Act, or enforced by Dean of Guild Courts, should be reviewed in the light of the new conditions set up by the Town Planning Act. For example, where population on the acre is as dense as it usually is with many-storied tenement houses development, certain expedients have been adopted to try to secure a modicum of fresh air for each person. Among these, the heights of rooms have been fixed much greater than is commonly adopted where cottage dwellings are built. It may or may not be some slight advantage for comparatively small cottage rooms to be 9 ft. or 10 ft. high; opinions widely differ as to whether any height above 8 ft. is really of advantage in such rooms; but it is hardly open to doubt that it would be a much greater advantage to secure an extra foot in the size of the room, and, further, that additional height over 8 ft. when all the rooms have windows looking out upon ample open space is, to put it at the highest, such a very small advantage that the local authority is not justified in compelling it. The cost had much better be spent in making the rooms a little larger, and under the town planning scheme, which allows rooms to be 8 ft. high, a provision requiring a minimum floor space or a minimum cubic space, or both, can be inserted. The two-storey cottage also does not need such a heavy form of construction. Questions of climate must, of course, be considered, but there is no reason to suppose that an 11-in. hollow wall would not be as weather-proof in Scotland as it is found to be in all parts of England; and it is doubtful whether in walls having one air cavity there is any necessity to strap the inside of the wall under the plaster to form a second cavity. Exactly what modifications in detail should be made, and how far differences of climate would affect these, as compared with the modifications found desirable in England, can only be determined after careful consideration of the new conditions by those having a knowledge of both systems of development. I wish only to emphasize the point that a local authority should not attempt to secure in connection with the dwelling the utmost in every direction that the particular surveyor may think desirable, but that they should secure the main conditions necessary for health, and should then leave to the individual builder some freedom to develop in one direction or another as may seem desirable for different classes of tenants.

Above all, let it not be supposed that housing reformers are asking for by-laws to be relaxed; nothing could be further from the truth. In asking for a limitation of the number of families which should be allowed on the average to occupy an acre of ground, housing reformers are calling for a far more drastic regulation than anything which has ever been proposed, one which so alters the character of development that it renders many old regulations no longer necessary, and what they seek is that certain minor requirements chiefly applicable to the older types of development, which are found to hamper the newer and better system, should be removed or adapted to the new conditions.

Certain other regulations should be considered also in reference to the introduction of

New Building Materials,

notably in regard to concrete and reinforced concrete, for both of which there is undoubtedly a future as building materials for dwellings in those districts where suitable aggregates are plentiful, and where the more ordinary building materials, brick and stone, are not so easily obtained.

The Town Planning Act gives power to control the character of buildings, and this would seem to carry with it the right to exercise some supervision over the general character of their designs and the materials of which they are composed, with a view to preserving or securing the amenites of the scheme. Such power has been exercised in the past by enlightened ground landlords in developing their estates, but has not been given to local authorities. It is admittedly a matter of some difficulty, because design or character cannot be defined in precise terms of a number of measurement, and, moreover, is subject to a certain variation of individual taste and opinion; but, none the less, I believe that some such control is desirable, and that the difficulties are less than appear. It is true that if you asked a dozen architects to design a building to fit a certain position, you would receive probably a dozen different designs; but, on the other hand, if you submitted any design for a building to a dozen architects, you would probably get an almost unanimous opinion as to whether that design was such as could reasonably be allowed to be erected in the particular place. There would be a general consensus of opinion which would rule out all designs below a certain quality, although of the designs above that quality there might be some difference as to which should be placed first. Now, in the regulation of design by a local authority, what is aimed at is not to secure absolutely the best among the many good designs, but to maintain a certain average standard, to preserve streets from being spoilt by the erection of buildings which are monstrosities of ugliness or bad taste. This I believe to be both practicable and desirable; but it is work that should not be attempted by a committee of laymen. The layman will very often know what he likes, and what he does not like, and his taste may be good, but he cannot tell what it is that causes him to like a building, and does not understand how a design fails or how it can be amended. Only the trained architect is qualified to exercise this function, and where the local authority desires to criticise the general character or design of buildings, it is at least due to those submitting plans that the criticism should be only entrusted to a well qualified architect, of such standing and independent position that he is not likely to be influenced by petty considerations.

What the municipal authority can do for architecture by means of a town planning scheme, and by the control of buildings, is not to secure fine architecture, but to grant an opportunity for its development, to prepare an adequate stage for its display, and to protect such fine architecture as may arise, and as I believe will arise, out of these better conditions from being spoiled by incongruous surroundings and the ugly freaks of eccentric fancy.

If by means of co-operation between the architectural profession and the municipal engineer a mutual understanding of this position can be secured, a very great step will have been taken towards the building up of more beautiful cities in this century than those which have resulted from the activities of the last.

System, as Applied to the Engineering Department

Specially contributed by J. L. Busfield, B. Sc., A.M. Inst. C.E., A.M. Can. Soc. C.E.

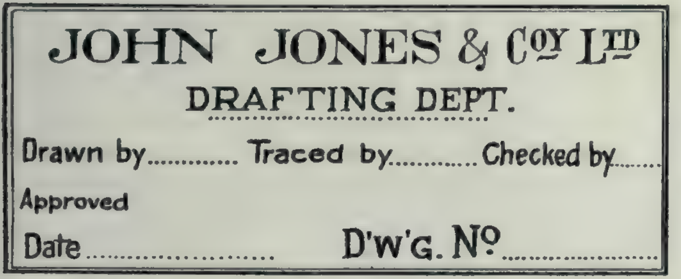
THE trend of modern conditions is to a higher efficiency in all walks of life, no matter whether it be in connection with the operation of a commercial enterprise or in the actual process of living. In the case of a commercial enterprise everything possible is done to counteract the increasing costs of human labor, raw material, etc., by insuring as high an efficiency of production as can be obtained. This applies not only to factories and constructional work but also to office forces. As an illustration it is only necessary to visit any large business office and view the many contrivances in use—from complicated calculating machines to small machines for sticking stamps on envelopes. At the same time highly scientific methods of accounting and bookkeeping are in use, not to mention the modern card indexes and filing systems. The use of these machines and methods has a very marked financial result, either by a reduction of office forces or by an increased production of the existing force.

The engineer or contractor is just as much concerned with this high efficiency of production as the commercial man, and all manner of appliances and constructional methods have been placed at his disposal to facilitate his work. The use of such appliances and methods is usually accompanied by a benefit which can be measured in dollars and cents, but the question arises: does the engineer carry efficiency into the details of his own office or engineering department where a direct financial return is not so apparent? When an engineer opens up an office, whether for himself or as a corporation employee, he will frequently—perhaps from motives of economy—omit to apply much system to his office and field work, but will make some plans and place them away in a cupboard relying on his memory or that of some assistant to produce them when required. Similarly with field notes and calculations, the former are no doubt taken in proper field books, but when filled the books are deposited in some drawer and allowed to accumulate indefinitely. Not infrequently they are made on scrap paper and when completed deposited in the waste-paper basket. These methods may work quite satisfactorily to start with, but as the business increases, and as time goes on, the plans and notes accumulate, and one's memory is not so reliable. Perhaps, also, an assistant with valuable knowledge of the whereabouts of plans and notes leaves the office, with the result that when some particular plan is required it has to be searched for among many others or cannot be found at all. When an office is first opened there may only be a few plans, etc., and with no definite knowledge of future requirements it is hard to determine on any proper system of filing and recording them. It is easy for the engineer to defer this matter until his business grows and he becomes too busy to devote his time to office system.

There are quite a number of different methods of filing and recording plans in general use. Perhaps the oldest and simplest is to roll up all the plans and place them in pigeon-holes or drawers. The disadvantage of this method is that small plans get pushed to the back of the pigeon-holes and become hidden and crumpled; and a small plan which has been kept rolled up becomes inconvenient to handle. It is now customary in all the larger engineering offices to file all the smaller plans flat in drawers, and to roll all the larger ones (say, over 48-ins. long) and file them either in pigeon-holes or drawers as found most convenient. Pigeon-holes are preferable, because a drawer large enough to accommodate the widest plans, i.e., about 42 ins., becomes awkward to handle. In cases where there are only a few large plans dealt with, it is sometimes quite satisfactory to fold them and keep them flat, but it cannot be recommended as good practice ever to fold a tracing. There are a great variety of drawers and cabinets for filing plans on the market, and it is unnecessary to describe them. In many cases a handy carpenter can knock together a suitable cabinet at very little expense. The drawers should be divided into compartments of different size, so as to avoid losing a small plan between two larger ones.

It is advisable to adopt certain standard sizes such as 18 ins., 24 ins., 36 ins., and 48 ins. in length, with two or three alternative widths for each size. It may be claimed that keeping to a standard size may lead to an unnecessary waste of tracing linen, but this is rarely so if the draftsman lays out his drawing with the foreknowledge that it has to fit one of the standard sizes. All plans should then be numbered according to their size, i.e., all plans 24 ins. long should have the prefix 24 in front of the serial number so that the only place to file plans with the prefix 24 would be in the compartment for 24-in. plans. The plans in each compartment should then be kept in numerical sequence, so that there could only be one correct place for filing any particular plan. For the long plans to be rolled and filed in pigeon-holes the prefix "R" might be used. Not only should all the plans conform to the standard sizes but when a number of plans are being made of one machine, building, etc., all should be kept to one size as far as possible without excessive waste of linen, so that when all the plans are completed they may be bound into a set (either tracings or blueprints), this being very convenient for reference. If a set of blueprints is made up in this way and kept in the office, it will frequently save a great deal of wear and tear on the original tracings. Wherever possible the filing cabinet should be kept in a fireproof vault. If the plans are at all numerous or valuable, the expense of building a small vault would be insignificant compared with that of replacing the plans, many of which it might be impossible to reproduce at all.

Having provided a suitable place for filing the plans in numerical order, it is necessary to have some ready method of obtaining the number of any particular plan. With regard to numbering plans, it is very convenient to have a rubber stamp made somewhat on the lines shown in Fig. 1. Such a stamp can be obtained very cheaply and if used in conjunction with a special black ink a very clear impression can be obtained both on a tracing and on blueprints made from the tracing. A "cache" of this kind, besides its usefulness in giving a record of the draftsman and drawing number, also gives a neat, finished appearance to the plan. Some engineers prefer to have the stamp made large enough to include the title, but this is a detail which may be left to individual taste. The indexing of the plan numbers requires considerable attention in order to meet with all the requirements and practically has to be studied for each different office, but there are some methods which will suit almost all conditions.



JOHN JONES & C^OY L^TD

DRAFTING DEPT.

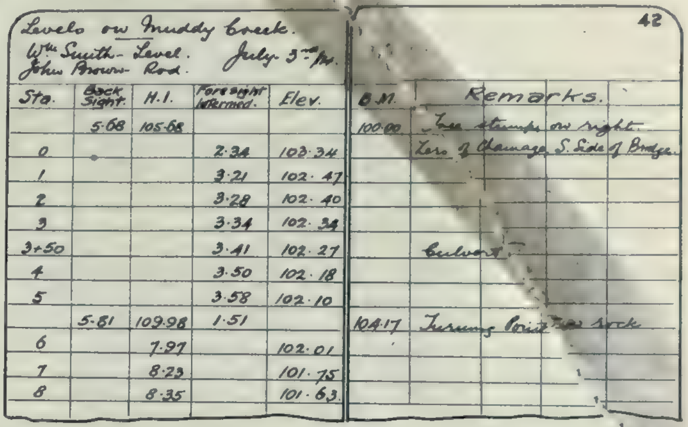
Drawn by............ Traced by............ Checked by........

Approved

Date........................ D'W'G. Nº..................

Fig. 1.

The first and simplest way is to have a book for the especial purpose of recording plan numbers. This book can be divided into sections for the different sized plans, the numbers being kept consecutive in each section. In a book for this purpose columns should be provided for the drawing No., date, name of draftsman, title, scale, and any remarks. As a basis for a complete index, a book of this form is both useful and necessary, but it is incomplete in itself, because, in order to find the number of any plan it might be necessary to search through all the different sections of the book, unless the size and date of the drawing were remembered. To make the system complete a classified index is required as an adjunct to the numerical index. This may be kept in another book, but the simplest and most convenient way is a card index. It is quite cheap to have cards prepared (costing about $2.00 a thousand) so that for every plan a corresponding card is filled in and placed in the classified index. The way the index itself is divided will naturally depend on the nature of the work performed in the office, but in all cases it should be so divided that no one section contains more than 30 or 35 cards. Main divisions, such as mechanical, structural, civil, should be made and each should be sub-divided into a number of smaller divisions for each distinct piece of work, or kind of plan. It is very frequently arranged that when the cards are made up they are written in duplicate on a typewriter so that two separate and identical indexes can be kept, one, say in the drawing office, and the other in the Chief Engineer's office. In some cases instead of having two identical indexes, it is desirable to have two classified differently, one, say, by the nature of the work, and the other by locality. In fact there are offices with no less than three separate indexes for plans; but two, used in conjunction with the plan record book will usually be found ample for all requirements.



Levels on Muddy Creek.
Wm Smith - Level. July 3rd /1?.
John Brown - Rod.

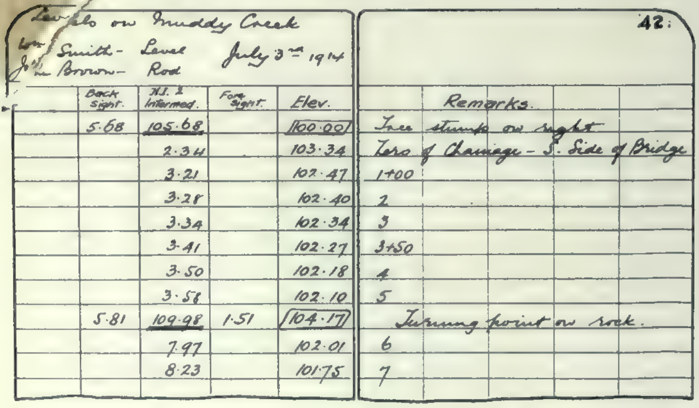
42

Sta.	Back Sight.	H.I.	Foresight Intermed.	Elev.	B.M.	Remarks.
	5.68	105.68			100.00	Tree stump on right.
0			2.34	103.34		Zero of Chainage S. Side of Bridge.
1			3.21	102.47		
2			3.28	102.40		
3			3.34	102.34		
3+50			3.41	102.27		Culvert.
4			3.50	102.18		
5			3.58	102.10		
	5.81	109.98	1.51		104.17	Turning Point [illegible] rock
6		7.97		102.01		
7		8.23		101.75		
8		8.35		101.63		

Fig. 2.

In an office where half a dozen or more draftsmen are employed, it is frequently an economy to engage an intelligent boy of 16 or so who can file all plans, and at the same time do odd jobs around the office. If a blueprint machine is kept he can make blueprints. Such a boy can keep the plan records, with a little supervision from the chief draftsman, but if it is not considered expedient to have a boy, the junior draftsman should be made responsible for the proper indexing and filing of plans. A system in use in an office which keeps a blueprint boy (and which works very satisfactorily) is for each draftsman on completion of a plan to write on a slip of paper, the title of the plan, with full particulars of size, date, scale, etc. The boy enters these particulars in the plan record book opposite the first vacant number for the size of plan in question, gives this number to the draftsman, and also writes it on the slip, which he retains. From time to time (say, once a week) these slips are given to the stenographer who types the particulars on to the index cards in duplicate or triplicate. The cards should then be placed in their respective sections by the chief draftsman or someone else thoroughly familiar with all the branches of the work.

In many offices it is customary to file plans, without using numbers at all, by keeping all those referring to one locality or piece of work in one compartment. This works quite satisfactorily provided the number of plans is small, but as soon as they begin to accumulate much time is apt to be lost in hunting for plans, and the expense and time involved in changing the system becomes very great. Whatever system is adopted it should always be made with a view to future expansion. Care must also be taken in filing the plans in the correct places, otherwise mistakes will occur, and a misplaced plan can cause no end of confusion. In a concern where there are a number of different compartments which are liable to use the plans, it is desirable to permit only one person to remove plans from the files, and he should keep a complete record of every plan removed and returned. The time involved in this operation is very small and will be amply repaid in the elimination of a great deal of trouble through mislaid plans. At the same time the chief draftsman or engineer-in-charge of the drafting department should keep a complete record of all blueprints given out to all other departments. This can be done either by keeping a book for the purpose or else by sending a memorandum with the prints and keeping the carbon copy on file.



Levels on Muddy Creek
Wm Smith - Level
John Brown - Rod
July 3rd 1914

42:

	Back Sight.	H.I. & Intermed.	Fore Sight.	Elev.	Remarks.
	5.68	105.68		100.00	Tree stump on right
		2.34		103.34	Zero of Chainage - S. Side of Bridge
		3.21		102.47	1+00
		3.28		102.40	2
		3.34		102.34	3
		3.41		102.27	3+50
		3.50		102.18	4
		3.58		102.10	5
	5.81	109.98	1.51	104.17	Turning point on rock.
		7.97		102.01	6
		8.23		101.75	7

Fig. 3.

Every draftsman or designer who does any calculating work should be provided with a book kept solely for this purpose. This book should be titled and indexed, however insignificant the work may appear at the time. Not only the draftsmen, but also the field men who have occasion to make computations in the office, should follow this rule.

With regard to the notes of the field men, it should always be insisted upon that every man taking notes, on however small a piece of work, should give full particulars (on the top of the first page) of the nature of the work, the date, names of men engaged in the work (with the position of each), and any other information pertinent to the work. If the survey is large enough to fill a number of pages of the notebook, this information should be repeated from time to time. It is surprising how frequently a transitman will omit to give any particulars of this nature in his notes, perhaps expecting to plot them and always refer to them himself, or intending to do so in the office. The importance of proper titling, etc., whether in connection with the field or office work cannot be impressed too strongly on the forces. A few minutes devoted to this may save hours of time and labour in the future. The actual method of taking notes requires careful attention, and too much care cannot be taken to insure that they will be equally as intelligent to a man in the office as to the man who makes them. It is unnecessary to give details here of taking notes, as this is discussed in all standard works on surveying. Every individual has methods of his own to suit his particular needs.

The form in which levels are taken differs very much with different men, but it is natural that the simplest form which will facilitate the mathematics, and also the reading of the notes for the final plotting, should be recommended. The form regularly shown in most text-books on this subject is shown in Fig. 2; and is no doubt used extensively with satisfactory results, but an examination of this form shows certain points which do not seem to conform with the requirements. For example, the information which is required as the final result of the levelling, that is, the stationing, the elevations, and the remarks are all separated about as widely apart as possible, whereas it seems more natural that these items should be kept adjacent. It is far easier to plot the notes from adjacent columns, and just as simple in making the notes. Again, taking the mathematical part, most men find it far easier to subtract figures placed vertically under one another, and as the Height of Instrument occurs only occasionally compared to the intermediate and fore-sights, it is surely simpler to place all these in one column, so that the subtractions can be made readily. The form of notes shown in Fig. 3 fulfils these requirements and is far simpler to make and easier to read in the office. Bench mark elevations can be identified from profile elevations by means of a circle. The levelman should also be encouraged to reduce his levels as he proceeds. There is usually time to do this while the rodman changes his position, and the reduction of the levels at the spot where they are taken frequently leads to a detection of a small error which might be overlooked otherwise.

When the field notes are turned in to the office, each book should be numbered and completely indexed, and a separate book should be kept as an index for all the books. A cabinet or drawer should be reserved specially for filing the notebooks so that ready reference may be made at any time to the original measurements of any piece of work.

In addition to the systematic and methodical arranging of plans, notes, etc., it is equally important that the work of the different men should be properly organized, but the conditions controlling this organization of work vary so that it is beyond the scope of these notes to deal with it. The financial value to the engineer or company of applying systematic methods to the engineering department, as outlined above, may be difficult to establish in dollars and cents, but there is no doubt that real benefits accrue, not only financially, but also in smoothness of working, and in elimination of small worries, such as a mislaid plan, or the duplication of work already performed.

The total quantity of Canadian Portland cement sold in 1912 was 7,132,732 barrels (1,248,228 tons), as compared with 5,692,915 barrels (996,260 tons) in 1911, an increase of 1,439,817 barrels or over 25 per cent. The total consumption of Portland cement in 1912, including Canadian and imported cement, was 8,567,145 barrels of 350 lbs. net each, as compared with 6,354,831 barrels in the previous year, being an increase of 2,212,314 or nearly 35 per cent, according to statistics issued recently from the Department of Mines.

Design, Test, and Cost Data on New Municipal Refuse Incinerator at Regina

IN the early part of 1907 the City Commission of Regina, Saskatchewan, decided to erect an incinerating plant to care for the refuse of their city. The contract was let to the Decarie Incinerator Company of Minneapolis, Minn., and a 50-ton, single-unit plant of the steel water-jacketed type was installed at that time. The incinerating furnace proper was constructed entirely of steel 10 ft. square by 12 ft. 6 ins. high, inside dimensions, with a 4-in. water space on all four sides and with a 2-ft. steam and water space above the crown sheet. Along two sides of the furnace were placed 1½-in. extra heavy pipes connected to the crown sheet at the top and to the firebox sheets at the bottom. The pipes were spaced at 9-in. centres and bent so as to form a basket grate to receive the refuse which was charged in from the wagons on the floor above through four 3-ft. square hopper openings in the crown sheet. By this means the refuse was suspended in an indestructible grate about 3 ft. above the lower or cast-iron shaking grates on which the material was finally consumed, giving the fire free access to all parts of the newly charged material without in any way obstructing the draft, or deadening the fire below.

This one 50-ton unit was installed in a brick building with wooden driveways to the upper floor, enabling the refuse wagons to come in on the floor above and deposit their loads directly into the furnace. Nothing but natural draft was provided and that was furnished by a steel stack 135 ft. high by 4 ft. diameter at the top.

At that time it was thought that a plant of 50 tons daily capacity would be amply large for several years to come; but Regina has shown a phenomenal growth during the past few years and late in 1912 it was plainly seen that in a few months the plant would need to have additional capacity. Consequently, steps were immediately taken by the city commissioners to outline a larger refuse disposal system for the city and one of sufficient size to care for future requirements. The city already had under construction additions to their 2,500,000-gal. sewage disposal plant which is located in the extreme northwestern portion of the city. The pumps to be installed here were to be electrically operated, and immediately the question arose as to the advisability of utilizing the heat generated by the burning refuse to help furnish the power for operating these pumps. It was known that the heat from a city's refuse is converted into electrical energy in many European cities and used to produce a source of revenue. It was also known that the incinerating plant built by the Decarie Incinerator Company, at Minneapolis, had for years been furnishing the power to light several wards of the city, and, consequently, it was decided to investigate the feasibility of such an arrangement in connection with the sewage plant.

Owing to the satisfactory results obtained by the original incinerator it was decided to let the Decarie Company make the city a proposition on a plant of larger capacity installed at the sewage disposal works with means provided for converting the heat generated into electrical power. The company agreed to construct a modern plant at the site of the sewage disposal works for the sum of $64,000, the plant to consist of a new 60-ton unit and the old 50-ton unit renovated and moved into the same building with the new one, making in all a plant with a guaranteed capacity of 110 tons in 24 hours. The plant also was to be equipped with two 100 h.p. Babcock and Wilcox water tube boilers, together with forced and induced mechanical draft.

In May, 1913, the contract was awarded to the Decarie Incinerator Company at the above figure. On December 1 the new plant commenced operation. The essential terms of the proposal as furnished by the contractors to the city were as follows:

Contractor's Guarantee

The new unit to be installed should have a capacity of incinerating 60 tons of refuse in 24 hours and the old unit after being remodelled and installed in the new plant should have a capacity of incinerating 50 tons of refuse in 24 hours. The refuse was understood to consist of kitchen garbage, combustible material, manure, and dead animals mixed together in proportions as created by the city of Regina from day to day, no attention being paid as to the selection of any particular kind of refuse or garbage. It was understood that manure would constitute 60 per cent of the refuse to be destroyed, all material delivered to the incinerator to be destroyed without creating any noxious odors or gases.

The total cost of operation was not to exceed 65 cts. per ton and if credit were given for power developed by the boilers, at the rate of 70 cts. per 1,000 lbs. of steam, the cost to be reduced by one-half, and if 30 per cent of the total refuse proved to be dry combustible the addition of fuel would be unnecessary.

It will be noted that the guaranteed cost of operation is somewhat higher than this firm usually guarantees. This was due to the large percentage of manure that had to be handled. However, as will be noted from the results of the final tests here given, this was a safe guarantee as the operating cost came to only 40 cts. per ton when burning 60 per cent of manure. The old plant had a guaranteed cost of 50 cts. per ton and operated at an average of 30 cts. per ton for the five previous years. The old plant handled no such percentage of manure as the new plant was required to handle. In fact in the old plant the city had difficulty in consuming the manure without additional fuel, as this plant was equipped with no mechanical draft whatever.

Design of Plant

The new plant is located on the bank of Wascana Creek, building being of concrete, brick and steel construction 44 ft. by 54 ft. inside dimensions. Two sides of the first floor of the building were formed by the concrete retaining walls. The remainder of the building walls are of brick. The hopper or charging floor is of reinforced concrete supported on steel beams. The standard gage steel car track, on which the refuse is delivered to the plant in special dump-cars, passes through the building at the hopper floor level.

The roof is of 3-in. concrete slab construction covered with tar and gravel roofing supported on steel purlins and trusses. I-beam trolley tracks are attached to the under side of the trusses over each unit, on which chain blocks operate to raise the heavy cast iron hopper covers and also the carcasses that are brought to the plant for destruction.

All material as it is delivered to the plant is dumped directly into the furnaces from the cars, without storage of the refuse being necessary. Drain connections to the sewer as well as water and steam connections are provided on the charging floor for keeping the cars and the floor in a sanitary condition. The incinerating furnaces and boilers, together with all the other necessary machinery, are located on the lower or operating floor.

The two separate units are of 60 and 50 tons capacity as stated above. Each unit consists of an incinerator, combustion chamber and one 100 h.p. Babcock & Wilcox boiler. A pre-heater or regenerator for heating the forced draft fan, direct connected to the chimney. An American Blower Company's induced draft fan, direct connected to a 11-in. x 8-in. automatic high speed self-oiling steam engine, is provided, as well as an American forced draft fan, direct connected to a 9-in. x 7-in. steam engine of similar construction. Four 5½ x 3½ x 6-in. March feed pumps are provided; one for each incinerator and one for each boiler.

The chimney is 5 ft. diameter at the top and 125 ft. high, of radial brick construction with octagonal, common brick, base set on a heavy concrete foundation just outside the building wall.

As can be noted from the illustrations the new incinerator is made with larger and narrower dimensions than the old unit; being 6 ft. wide by 18 ft. long by 10 ft. high, inside dimensions. It has 4-in. water legs and a 2-ft. steam and water space above the crown sheet. With these proportions the labor necessary for stoking is materially reduced, and as the number of stoking doors is much smaller, not nearly as much cold air is drawn into the furnace.

The longitudinal header, connecting the two end water spaces and into which all the 2-in. basket pipes are connected at their lower ends, is made of 12-in. extra heavy pipe in the new incinerator and 8-in. extra heavy pipe in the old one. As will also be noted from the sectional illustrations the pipes forming the basket grate do not connect into the inside plates but come through the water leg and by means of union tees and elbows connect into the outside sheets. This arrangement enables these pipes to be kept thoroughly clean by means of plugs located in the tees.

Operation of Plant

The refuse enters from the upper floor through the balanced doors in the brick lined hoppers and drops into the basket grate. As it burns in this position, and on the shaking grates directly beneath, the gases pass into each respective brick-lined, steel-cased combustion chamber where they are thoroughly mixed and burned before entering the boilers through the side wall directly over the boiler grates. The gases then pass around the water tubes of the boiler giving up a large amount of their heat to the generation of steam in these tubes. It will be noted that by this arrangement the boilers can be operated simultaneously with the waste gases and with coal in case the heat from the refuse is not sufficient to maintain a constant pressure. This condition is likely to occur in wet weather or when the heat value of the refuse is exceptionally low.

After leaving the boilers the gases pass under the floor and up through the pre-heater, or generator, direct to the chimney; or they may be drawn through the induced draft fan in the chimney as the conditions may require.

The one pre-heater and the induced draft fan serves for both units or for either one of the two units if only one unit is in operation. The pre-heater contains 740 2½-in. boiler tubes expended into ⅜-in. steel plate heads, the gases passing through these tubes on their way to the stack. The air supply for the forced draft fan is taken through a duct leading from the ceiling of the upper floor to the pre-heater, thus removing all the foul air from the building that might come from the refuse as delivered. This air is drawn through the pre-heater around the tubes through which the hot gases are passing, taking up enough of this heat from the waste gases to raise the temperature of the air going into the forced draft fan to the temperature of from 150 to 400 deg. F. The forced draft fan forces this heated air through concrete ducts below the floor to the ash pits of the two incinerators. It enters the pits directly under the grates through suitable control nozzles at a maximum pressure of 4½ inches. It might be stated that the ash pits of each incinerator are divided into sections so that the forced draft can be shut off entirely, in any one section and the fire cleaned on that section of grates without hindering the operation of the other sections of the grate. The use of this hot forced draft has shown itself to be the most essential feature in the burning of manure and the saving of additional fuel. In case only natural draft is used, as in starting up when the steam pressure is down, an opening is provided to the outside of the building so that air can be drawn directly into the ash-pit, thereby removing the necessity of opening the ash-pit doors. This feature is especially valuable in the winter time when the lower floor is well sealed up to prevent the cold air from coming into the building.

Each unit is also provided with a by-pass direct from the respective combustion chambers to the chimney, thereby enabling the boilers and pre-heater to be entirely cut out in case, for any reason, repairs should be necessary, or if occasion should arise, the boilers and incinerators can be operated entirely independent of each other.

The boilers are installed to work at 160 lbs. pressure per square inch; the ultimate plan being, as stated, to use the steam from the boilers for the generation of the electric current for the sewage pumps. The generator set has not yet been installed but very likely will be in the near future.

The incinerators are designed to operate at 100 lbs. per square inch steam pressure, but in the continuous operation of the plant as a steam generating station each incinerator operates as a feed water heater for its respective boiler, and fans being operated by the steam from the boilers. The piping is arranged so that in starting up the plant, or, when the boilers are shut down, the incinerators can furnish the necessary steam for the fans and pumps.

The blow-offs from the incinerators lead into the respective combustion chambers and those from the boilers lead to the atmosphere through a 5-in. pipe. The exhausts from the pumps and fan engines pass through a 6-in. pipe directly into the base of the chimney.

A men's room containing toilets, wash stands and lockers, as well as other modern conveniences is provided on the operating floor.

The installation of the complete equipment, except the old incinerator, was completed Dec. 1, 1913, and the plant commenced operation that day. It was agreed by the city that a test of the capacity for the 60-ton unit would determine the fulfilment of the guarantees as the city could not without great inconvenience supply more than 60 tons of refuse in 24 hours. The 50-ton unit could not be dismantled at the old plant until the new plant was in operation and consequently the installation of the old unit in the new plant has just recently been completed after it has been overhauled and equipped with the new system of piping.

Refuse Hauling

Near the site of the street car barns the city has erected a loading station and a stable, and it is here that collection wagons deliver their loads of refuse into the dump-cars.

The loading station is a brick and reinforced concrete building two storeys high, 46 ft. x 146 ft., and was erected at a cost of $16,000. A siding of the Municipal Street Railway runs through the building at ground level and in this siding are placed the 5-cu. yd. steel dump-cars especially designed for this service. The loaded collection wagons enter on the second floor by means of an approach at the end of the building and dump their contents directly into the cars.

The stable is also of brick construction erected at a cost of $23,000 and provided with single stalls for 32 teams, together with 4 box stalls. The wagons are housed under the second floor of the loading station.

Test Data

The first of the three test periods held on the new plant occurred on Dec. 1, 1913, under the supervision of the builders, with the following results:

Date of test—December 1, 1913.
Duration of test, hours—22.
Grate area, sq. ft.—108.
Material incinerated—

Manure, lbs.	57,240
Garbage, lbs.	55,480
Fruit, lbs.	2,800
Fish, lbs.	3,500
Horses, lbs.	1,500
Total material destroyed, tons	60.26
Percentage of manure	47.5
Percentage of ash	10.0
Refuse burned per hour, tons	2.74
Equivalent incineration in 24 hours, tons	65.76
Labor required—	
One engineer 22 hours at 50 cents	$11.00
Three firemen 22 hours at 30 cents	19.80
Labor cost per ton, cents	51.1
Cost of fuel required—200 lbs. coal and ¼ cord kindling	$3.00
Total cost of fuel	$3.00
Fuel cost per ton refuse, cents	.049
Total cost of operation per ton refuse, cents	.56

Although this first test fulfilled the guarantees of the builders the city desired to run another test with the regular city crew operating the plant. They also desired to have the requisite quantity of manure on hand to make up the 60 per cent. that was stipulated in the contract. Consequently on December 12, 1913, a second test was run with the city's crew operating the fires, the following results being obtained:

Date of test—December 12, 1913.
Duration of test hours—9.5.
Grate area, sq. ft.—108.
Material incinerated—

Manure, lbs.	23,310
Garbage and refuse, lbs.	24,460
Total, lbs.	47,770
Total material destroyed, hours	23.89
Percentage of manure	48.8
Percentage of ash	10.0
Refuse burned per hour, tons	2.51
Equiv. incineration in 24 hours, tons	60.24
Refuse burned per sq. ft. grate per hour, lbs.	46.5
Labor required—	
Engineer, 9½ hours at 50 cents	$ 4.75
Three firemen 9½ hours each at 25 cents	7.12
	$11.87
Labor cost per ton, cents	49.7
Fuel required—No coal used. Small amount of kindling wood to start.	
Total cost fuel required, dollars	0.50
Total cost per ton refuse, cents	2.1
Total cost of operation, per ton, cents	51.8

The plant demonstrated in this second test that it could be operated within the guaranteed cost by the city's men, but again the 60 per cent. of manure was not available. Consequently a third and final test was held on January 7, 1914, the results being as follows:

Date of test—January 7-8, 1914.
Duration of test, hours—19.0
Grate area in sq. ft.—108.
Material incinerated—

Garbage and refuse, lbs.	48,870
Manure, lbs.	74,100
Total lbs.	122,970
Total material destroyed, tons	61.49
Percentage of manure	60.3
Percentage of ash	10
Refuse burned per hour, tons	3.24
Equiv. incineration in 24 hours, tons	77.76
Refuse burned per sq. ft. grate per hour, lbs.	60.0
Labor required—	
One engineer 19 hours at 50 cents	$9.50
Two firemen 19 hours at 25 cents	9.50
	$19.00
Labor cost per ton, cents	30.9
Fuel required—	
½ cord wood	$4.00
200 lbs. coal	1.00
Total cost of fuel required, dollars	5.00
Fuel cost per ton refuse, cents	8.1
Total cost operation per ton refuse, cents	39.0

The information given in this article was furnished Engineering and Contracting by the Stacy-Bates Company of Minneapolis.

There are several railway gages in Europe, but in the United States and Canada it is possible for a truck to travel from Prince Rupert to New Orleans, and from Quebec to San Francisco without hindrance. This was accomplished at great expense some twenty or thirty years ago. In Europe the bulk of the mileage is the standard 4 ft. 8½-in. gage. There are, however, some other gages, especially the meter gage in France, Belgium, Italy, Spain and Portugal. The most important exceptions are in Spain and Portugal, where they have nearly 10,000 miles of the 5 ft. 6-in. gage, and in Russia and Finland, where there are 30,000 miles of the 5-ft. gage. This 3½-in. difference from the standard was adopted by the Russian Government to avoid the dangers of invasion. The only connection between France and Spain is at Irun, on the Biscayan coast, but the Pyrenees are now being pierced at more than one place, and a question of conforming the gage of Spain and Portugal to that of the bulk of Europe has arisen.

An Outline of Present-Day Practice in Water Filtration

PRESENT-DAY practice in water filtration was the subject of an interesting paper read by Mr. G. A. Johnson at the recent convention of the American Waterworks Association. Mr. Johnson began with a history of filtration abroad, followed by that of United States cities, the latter beginning in 1875 with the Poughkeepsie slow sand filter. He gave a brief description and statement of the operation of most of the larger filters, both slow sand and rapid, which have been constructed since that time. These included the slow sand filters at Lawrence, Mass., Albany, N.Y., Washington, D.C., Philadelphia, Pa., and Pittsburg, Pa. The rapid sand filters specially described were those of Little Falls, N.J., New Orleans, La., Cincinnati, O., Louisville, Ky., and Columbus, O. In this connection he gave a list of all the filter plants, both slow and rapid, which have been constructed in the United States. Space does not permit more than a gleaning of a few of the more interesting statements from the paper.

Concerning the Philadelphia plant, he stated that when the turbidity of the Delaware river exceeds 100 parts per million for prolonged periods, the Torresdale plant is utterly unable to cope with the problem. The pre-filters fail to do their proportion of the work and the slow sand filters choke badly and allow fine silt to pass to a depth as great as ten inches.

Concerning the Pittsburg filters, he stated that actual experience with them had failed to confirm the judgment of the filtration commission in adopting slow rather than rapid sand. The bacterial efficiency was poor and on one day in December, 1909, 120,000 bacteria per c.c. were found in the filtered water, and the use of hypochlorite was begun. This plant, he said, was watched more carefully than almost any other in existence, and this more than anything else prevented the signal failure of the plant, but it required a high grade of technical skill to enable the works to handle this, the most difficult water which a slow sand filter plant is called upon to purify in this country. The problem was studied during 1910 and 1911 as a result of which, preliminary filters and latitudinal baffles were built, this work being practically completed last December and there still remaining to be installed appliances for introducing coagulating and correcting chemicals. In spite of these difficulties, the use of the filtration plant has reduced the typhoid fever rate from an average of 125 per 100,000 for the nine years before filtration to an average of 10 for the four years succeeding filtration—a result never equalled in the history of water purification.

The first municipal rapid sand filtration plant was built at Somerville, N.J., in 1885, and up to January, 1914, more than 450 municipal plants of this type had been built or were under construction, with a total daily capacity of 1,745,000,000 gallons and twelve million people supplied. About 1900 the type of construction changed abruptly from circular wooden or steel tanks to rectangular concrete tanks. The plant at Little Falls, N.J., was the first one built wherein the tanks were of rectangular concrete construction, this being completed in 1902. In numerous respects all of the rapid sand filter plants built since then have been patterned after this with respect to the scheme of layout and the automatic or easily manipulated hydraulic and electrical contrivances. This plant serves several cities, the largest of which is Paterson, and the average death rate from typhoid fever in this city for the five years prior to filtration was 32, which was reduced to 9 for the ten years following filtration.

In the New Orleans, La., plant, lime and sulphate of iron are used as coagulants and the filters are cleaned by water alone under high velocity. The amount of wash water used averages the very low figure of 0.4 per cent. of that filtered, this being due to the very complete preparatory treatment of the water in sedimentation and coagulating basins prior to its application to the filters. The use of the filtered public supply has been taken up very slowly by the citizens, only about one-half of the population being connected at the end of 1912. Also the introduction of a new sewerage system and other sanitary improvements in the city make it uncertain how much should be credited to the water supply. In 1912, however, the typhoid fever rate was 58 per cent. less than for the thirty years previous to filtration.

The Cincinnati plant is the largest rapid sand filter in the country, although those under construction at St. Louis and Baltimore are larger; the Cincinnati plant having a daily capacity of 112 million gallons, Baltimore of 128 million and St. Louis of 160 million. In Cincinnati the raw Ohio river water is first allowed to settle for about three days in a large reservoir, coagulant is then added and from two to three hours allowed for coagulation and supplementary sedimentation, and the water is then applied to the filters. Three and a half per cent. of wash water is used. The turbidity is reduced from 190 to zero, the bacteria from 8,900 to 75, these being averages for the year 1910. The typhoid fever rate has been reduced from an average of 55 for the eight years previous to filtration to 11 for the five years following.

The Louisville, Ky., plant was placed in operation in 1909. The wash water used averaged 2.37 per cent. during 1911, and the turbidity was reduced from an average of 225 to zero and the bacteria from 10,300 to 135. The typhoid death rate was reduced from 56 for the ten years previous to filtration to an average of 25 for the three years following.

The Columbus, O., plant was put into operation in 1908, and it is designed to soften the river water as well as to clarify and otherwise purify it. This water is not only frequently muddy, but is one of the hardest in the country. The average amount of chemical used in 1911 was 7.5 parts of lime, 4.3 of soda ash and 1.57 of sulphate of alumina. On the average the turbidity was reduced from 68 to 0, hardness from 245 to 84, alkalinity from 150 to 45, inculstants from 45 to 38 and bacteria from 11,470 to 55. The typhoid death rate has been reduced from an average of 62 for the nine years preceding filtration to 17 for the four years following.

Concerning the use of coagulants, Mr. Johnson states that the chemicals most commonly used are compounds of aluminum and iron, of which potash, alum, sulphate of alumina and sulphate of iron are those most extensively employed. The essential feature in selecting chemicals is that the chemical shall be basic, namely, that it shall contain more available alumina or iron than is required to combine with dissolved sulphuric acid, and that it shall contain no free sulphuric acid.

Under some circumstances the carbonic acid liberated by the application of chemicals increases somewhat the rate at which the water corrodes some unprotected metals, although no more so than the best ground water supplies to the country. The carbonic acid may be removed by the addition of lime. For ordinary uses no change as regards hardness due to coagulants can be detected, but where water is boiled or used for steam raising purposes, it is a little less satisfactory after coagulation on account of the increased amounts of incrustants, although the increase is very small.

To obtain satisfactory results from the use of lime and iron as coagulants, it is necessary to add sufficient lime to neutralize and precipitate the iron. This must be done carefully, for the use of too little lime results in poor coagulation caused by the incomplete precipitation of iron, some of which may appear in the effluent of the coagulating basin, while too much lime causes incrustants to form, which are liable to cause trouble by being deposited in the sand bed and in pipes and valves.

Where waters are very muddy it is desirable to precede the filtration by sedimentation, and if this is to be aided by preliminary coagulation the sedimentation basins must be sufficiently large to permit of adequate subsidence of coagulated matter before the water reaches the filters. Otherwise, the filters will clog too quickly and require too frequent cleaning. The basins should be well baffled and have a capacity of 18 to 24 hours' flow, or several days' flow if not well baffled. The use of coagulants in this way before applying water to slow sand filters is quite successfully practiced at Springfield, Mass., Ferncliff and Poughkeepsie, N.Y., Indianapolis, Ind., Washington, D.C., and elsewhere.

Concerning the so-called red water plague, Mr. Johnson states that where sulphates of iron or alumina are used in the preparation of water for filtration and lime or soda are not also used, there is an increase in the amount of carbonic acid of three to four parts per million for each grain of coagulant used per gallon of water, and this free carbonic acid increases the corrosive action of water on metals. He disputes, however, the claim made that coagulating water is responsible for the more or less common run of red water troubles, but believes that these would in most cases be experienced without coagulation.

Cost Data

Concerning the costs of slow and rapid sand filters, he makes a comparison including in each case the buildings, filters and all appurtenances, preliminary sedimentation basins, filters and clear water reservoirs. The greater area required for slow sand filters makes the land required cost about twenty times as much as for slow sand, and furthermore makes it more difficult to find a site for the filters without going long distances. He presents a table of costs of seven slow sand filters and eight rapid sand filters, the construction costs given by him ranging from $20,000 per million gallons daily capacity to $45,200 for slow sand filters, and from $10,300 to $15,000 for rapid sand filters, the averages for the two sets being $32,600 and $12,100 respectively. At 5 per cent. the fixed charges on these sums would amount to $4.47 and $1.66 respectively per million gallons filtered. He likewise gives the cost of operation and maintenance of the seven slow filters and of five rapid filters, the former varying from $1.91 to $5.62 per million gallons filtered, and the latter from $3.20 to $6.32, the averages being $2.86 for slow sand and $4.04 for rapid sand. Adding these two cost figures, we have a total of $7.33 per million gallons for slow sand filtration and $5.70 for rapid sand.

Concerning the relative efficiency, he claims that well designed and built rapid filter plants not only can purify water of any character, turbid, colored or clear, so that the filtered product will always be clear and colorless, but also are less liable to show sharp diminuation in bacterial efficiency in cold winter months or when the character of the raw water is seriously contaminated with certain industrial wastes. "Wherever chemicals are or should be used in the preparation of water for filtration, it is proof that the slow sand filter is out of its element and in a field which, on grounds of economy at least, belongs exclusively to the rapid sand system." He compares the reduction in the typhoid death rates by seven slow and six rapid sand filters, and finds that the average rates after filtration are 22 for the slow sand filters and 16 for the rapid sand. He uses this as an argument in favor of rapid sand, but fails to call attention to the fact that the average rates before filtration were 81 in the cities where slow sand filters were built, and only 44 in those where rapid sand filters were adopted; a comparison of these averages showing that while the slow sand filters reduced the death rate by 73 per cent., the rapid sand reduced it by only 64 per cent.

Discussion

In discussing this paper, the point which received the most attention was the comparative costs of filters, and it seemed to be the general, if not universal, opinion that the author had not made a fair presentation of this question; that is, the figures given for slow sand were too high and those given for rapid sand much too low. The discussion was opened by J. H. Gregory, who stated in substance that land for slow sand filters was not often difficult to obtain, and that quite commonly it was found as cheap to purchase an area large enough for a slow sand filter as to obtain a smaller portion of a tract sufficient for the rapid filter only; citing as instances, Pittsburg, Philadelphia and New York, several sites being found by the latter city for filtering the Croton supply and also in the Catskills for the new supply. At Cincinnati land was found equally available for either slow or rapid filters, also at Columbus, and at the latter city sufficient area was taken for slow filters, although rapid ones were used.

The cost, Mr. Gregory said, depends largely on the capacity of the coagulating and clear water reservoirs. These were nine times as large in New Orleans as at Little Falls, which accounts largely for the difference in cost. At Philadelphia the puddling of the filter walls and other special construction (and politics, said John Trautwine, Jr.) made the cost higher. At Montreal the cost of slow sand filters averaged only $22,630 per million gallons, including a low lift pumping station, or $21,000 without the pumping station. The cost of the Columbus plant was between $14,000 and $15,000 and not $13,000 as stated by Mr. Johnson. Other rapid sand filters were those at Toledo, O., costing $14,500 or more; Grand Rapids, costing $16,300, omitting items not chargeable to the filters. At Cincinnati the settling basins should be included as part of the plant, and including half the cost of these, gives the cost per million of $18,-

200 instead of $11,400 given by Mr. Johnson. The New Orleans plant cost only $30,160 if the non-filter structures be omitted. The weighted average of the several plants referred to by Mr. Gregory gave $18,600 as the average cost of rapid sand filters instead of $12,100 of the author; and these are all the latest and best plants of this kind. The author's figures were not only much too low for rapid sand, but were too high for slow sand filters.

Mr. J. N. Chester agreed with Mr. Gregory's conclusions in a general way, and stated that the cost of the modern large rapid sand filters was more per million gallons than the small, because more conveniences in the way of appliances for controlling the filters were being demanded. He stated that he built the third slow sand filter in the United States at Mount Vernon, the cost for 1.4 acres being $22,000, but this was built by damming off a reservoir and filling with sand which was dug on the spot. Rapid plants could be built cheaply, he said, by using wooden tanks, wrought iron pipe, etc., but cost of operation and depreciation would be high. On the other hand, $2,000 to $6,000 per million gallons is often put in a head house, administration building, hydraulic valves, etc. R. S. Weston agreed with Mr. Gregory as to the matter of cost. Some time ago he fixed upon $14,500 per million as the average cost for a rapid filter and $100,000 per acre as the average for a slow filter, and believed that the latter could be used at the rate of six million gallons per acre if hypochlorite be used for sterilizing. R. E. Milligan cited Jerome Park as a proof that large plants need not necessarily cost more per unit than small.

C. B. Burdick called attention to a common error in assuming that a plant operates at 100 per cent. of its capacity every day, stating that in practice the actual capacity was but 40 per cent. to 85 or 90 per cent. of the theoretical. Allowance for this would raise the cost per million gallons filtered. H. C. Hodgkins considered that 8 per cent. rather than 5 per cent. should be allowed for the fixed charges.

Mr. Weston said that the Pittsburg and Washington filters should have been rapid sand, while Mr. Chester said that Pittsburg was just on the limit of turbidity where this was a question. Mr. Weston set the limit of turbidity at 30, and the limit of color at 50, above which rapid filters should be used. He agreed with Johnson that rapid filters should be used under many conditions, but advocated slow filters for clear water and where sand and construction were low.

Mr. Milligan advocated rapid filters at a 240-million gallon rate for removing iron instead of slow filters at a 10-million gallon rate. He also believed that pressure filters would again become popular, with the effluent probably sterilized. Paul Hansen thought pressure filters should be adopted with caution, as they do not allow of coagulation and sedimentation prior to filtration. Mr. Chester agreed with Hr. Hansen in opposing the use of pressure filters, one objection being that he has always found unwashed sand in the bulge of horizontal cylindrical filters.

W. C. Hawley stated that if the decision was to be made to-day, Pittsburg would probably adopt rapid filters, briefly describing other rapid filters recently built by private plants just above Pittsburg.

Professor Dallyn did not consider the total death rate of any value as a basis of comparing improvement in health conditions due to water, unless the infant rate was excluded, since this was a very large percentage of the whole, and usually depends upon the milk supply rather than upon the water supply.

Cement Joints for Sewer Pipe at Edmonton, Alta.

By J. M. Begg*

THE difficulty of getting in Edmonton a sufficient number of skilled pipelayers and inspectors has led me to consider carefully present methods of making cement joints in sewer pipe. It is a simple series of operations and yet like many other simple things it is not always well done. Perhaps it is just because it is a common daily part of the work, that it is apt to be overlooked. Once a sewer is covered up, and the sewage entering it gets away freely, it is assumed that the sewer is in good working order, but that is not always so. The sewage may be getting out, or ground water may be getting in to an extent that seriously decreases the capacity of the sewer.

The common method of specifying sewer joints is to require a strand of oakum or hemp gasket all around the inner part of the joint and cement mortar to fill up the rest of the jointing space. The gasket prevents the mortar from entering the barrel of the sewer. In making a joint of this kind, the usual procedure is to dig a hole under the bell of the pipe last laid, insert the next pipe, calk the gasket all round the joint and complete the joint with cement mortar, using the hands to get it in under the pipe. From Ogden's "Sewer Construction," I take some directions typical of those which cover this method:

> All pipes and special shall be laid to the grade given by the engineer . . . special care being taken that there is no sagging of the spigot end in the hub. . . . A narrow gasket of jute shall be provided by the contractor, to be well soaked in neat cement grout and introduced between the hub and spigot, and well and properly rammed. It shall in all cases be driven to the bottom of the hub to leave room for the mortar as specified. The space between the spigot and hub shall then be entirely filled with mortar thoroughly pressed in on the bottom, sides and top, and every precaution taken to secure a watertight joint. The mortar shall be applied with a rubber mitten and rammed or compacted with a wooden calking tool. The joint shall be finished with a neat and generous bevel made with the mitten.

A careful and conscientious pipelayer can make an excellent joint in this way; but it is obvious, that, if he is at all slovenly, the lower half of the joint, which in a sewer is the vital part, is more likely to suffer. It is the most difficult part to get at, and the larger the pipe, the greater is the difficulty. The danger is increased if the contractor is pressing the pipelayer to get along quickly and if the inspector is inclined to keep to the top of the trench. From that position he cannot see what the pipelayer is doing with his hands under the pipe. On a small job, where there is ample opportunity for careful inspection, and time is available, the method is not likely to be found unsatisfactory, but with thirty or forty miles of construction to cram into six months, I have found it apt to break down here and there.

If the pipelayer has any latitude at all, as often as not he backslides and adopts another and easier method. Before laying any pipe, he places some mortar in the lower part of the bell of the pipe already laid, inserts the next pipe, and then finishes the upper part of the joint with oakum and cement, or with cement alone. Such a method leaves little chance of a leaky joint below the water run, but another danger is incurred. In the very act of inserting the pipe, the pipelayer is likely to squirt some of the mortar into the barrel of the sewer. This mortar, of course, can easily be removed with a scraper or a tight-fitting bag, but the pipelayer again may neglect to do this and the inspector may fail to detect it in one or two lengths.

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* Assistant City Engineer in charge of Sewers.

I do not see how one can avoid running one or other of these two dangers. The engineer, who cannot always be on the job himself, can only choose the method that seems to him to offer the least chance of being carelessly carried out. The one method—calk-oakum all round the joint before adding any mortar—involves the risk of a leaky joint, owing to the irksomeness of getting mortar into the bottom; the second method—placing mortar in the bell before introducing the next pipe—involves the risk of cement getting inside the sewer and forming a little ridge across the water run. In spite of this possibility, I have come to think this latter method the less dangerous. As a rule, not a great deal of cement does actually squirt through into the sewer, and the pipelayer has little temptation to omit cleaning out what does get in. Incidentally, I prefer the wooden scraper to the bag hauled through the sewer with a rope as pipelaying proceeds.

A Point About Bell Lining

But many engineers who specify this method of first lining the bell with cement overlook an important point. Cement mortar alone in the bell will not support the spigot end of the next pipe. The spigot sinks down into even the stiffest mortar, and if the whole line is laid in this way you get a water run like the edge of a saw. Very little pressure is required to squeeze down the pipe into the bell. If the pipelayer steps on the pipe or if the backfilling is thrown on top of it while the mortar is green, it is enough to cause it to sag, even if the weight of the pipe itself does not carry it down. It is advisable, therefore, to lay a piece of hemp, about 6 ins. long, on the lower part of the bell and then place the mortar on top of it. This may seem a clumsy proceeding but, if you try to introduce the hemp afterward, you will find you need to calk it away into the bell to raise the pipe in such a way at all. To raise the pipe with a chip of wood in the bell will not do as it lifts the spigot off the mortar, and any method of making the pipes concentric which depends on a finical trimming of the trench is not likely to be very successful.

In his "Engineering Work in Towns and Cities" (1908) Ernest McCullough quoted a specification which reads in this way:

> Joints shall be made as follows: (1) Line with mortar the lower third of the entire circumference of the bell; (2) insert the pipe to be laid and a jute gasket freshly dipped in neat grout; (3) bring the pipe to grade and line; (4) calk the gasket tightly into the joint; (5) fill the joint with mortar mixed rather stiff, using a rubber mitten; (6) tamp mortar into joint with an approved tool until it is solidly filled; (7) smooth on mortar, using a rubber mitten; (8) protect the cement (preferably with burlap) and fill around the barrel of pipe with sand or similar material, tamping solid with an approved tool; (9) remove burlap and cover joint and pipe with fine material; (10) clean out and point joint on inside of pipe.

This is a better clause than is found in most specifications, though the manner of conducting operations (2) and (3) is not very clear. Mr. McCullough, in a note, states that he fails to see the necessity for specifying a gasket in sewer-pipe joints, except when the sewer is laid in water. But, as a few minutes' experimenting on the ground will show, it is difficult to get an even water run without the gasket in the bottom. The gasket in the top half of the joint is, of course, a safeguard against cement getting into the pipe. It may be argued that as we have to clean out any cement that gets in at the lower part of the joint, a little from the upper part will not materially add to the danger; but it is advisable to reduce the danger to a minimum.

The Edmonton Specification

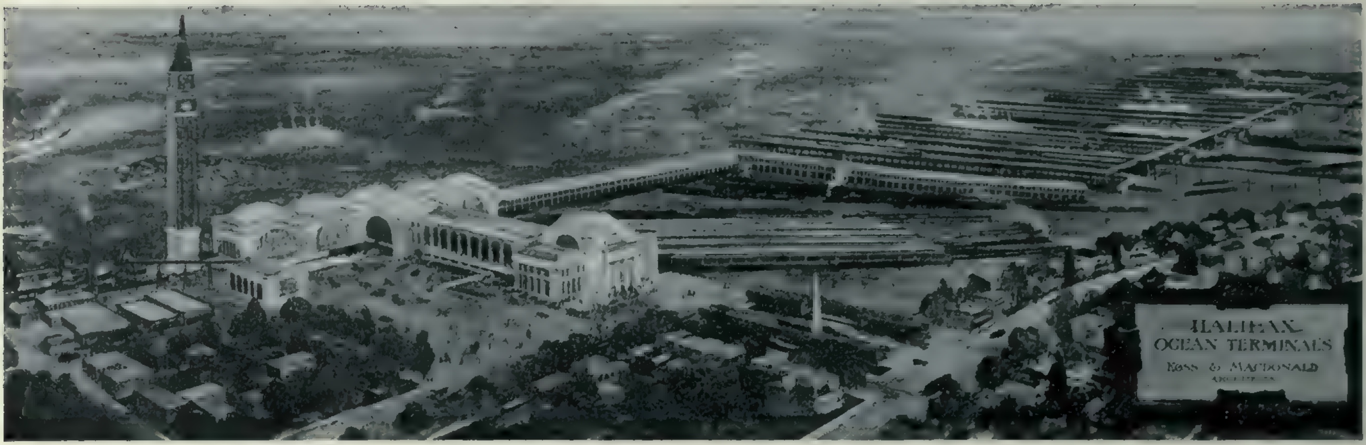
The following is the specification we use at present in Edmonton:

> The ordinary joint shall be made in the following manner:
>
> (a) Lay along the lower quarter of the bell and just at the entrance a piece of Russian hemp or other approved material freshly dipped in neat cement grout. This hemp is to keep the pipe to be laid next from sinking into the mortar in the bell and must therefore be thick enough to keep the pipes concentric.
>
> (b) Line the lower third of the bell with stiff mortar, covering completely the strand of hemp.
>
> (c) Insert the pipe to be laid, pushing it home until it is hard against the inner end of the bell. Great care must be taken to see that the spigot end of the pipe rests on top of the hemp and does not catch it and jam it back into the bell.
>
> (d) Calk into that part of the bell not already filled with mortar a strand of gasket freshly dipped in neat cement grout. This gasket after calking must not take up more than one-quarter of the space available in the bell for the whole joint.
>
> (e) Fill the joint all the way around with stiff mortar, using a rubber mitten, and finish off the outside of the joint both top and bottom with a neat bevel. But no joint is to be completed in this manner until at least two joints have been calked in advance with the gasket as described in paragraph (d).
>
> (f) Clean all cement from the inside of pipe up to 15 in. diameter by using a wooden scraper made in the form of a semi-circle. Pipes over 15 ins. and less than 22 ins. diameter to have the lower half of the joints pointed on the inside. Pipes 22 ins. diameter and over to have the joint pointed all the way around on the inside.

The method so specified is no doubt open to criticism but it is an attempt to work out a method which, taking full account of human nature and the actual conditions of pipelaying, should reduce the danger of leaky joints to a minimum. The trouble is not that a contractor may be dishonest. A good joint can be made about as easily and cheaply as a bad one. The trouble is simply that the pipelayer may find it awkward to make the bottom of the joint carefully and it is important to have a standard method that insures easy inspection and leaves as little room as possible for careless workmanship. There is nothing in the method suggested which a contractor could consider a hardship. It is easier than the method of calking a gasket all the way round before adding the cement, and it takes the same material. The latter method is almost sure to lead to leaky joints, if inspection relaxes for even a short time, or if the work is at all hurried.

It might after all be argued that the method I have recommended needs rigid inspection just as much as the other. It does need careful inspection, but this much at least can be said for it that once a pipelayer becomes accustomed to it there is little or no temptation to depart from it even if the inspector's back is turned.—Engineering News.

A miniature of the Panama Canal, built on a scale of 6½ ft. to the mile, is to be operated at San Diego, Cal., during the exposition next year. A contract for constructing the model has been awarded. The cost is estimated at no less than $250,000.



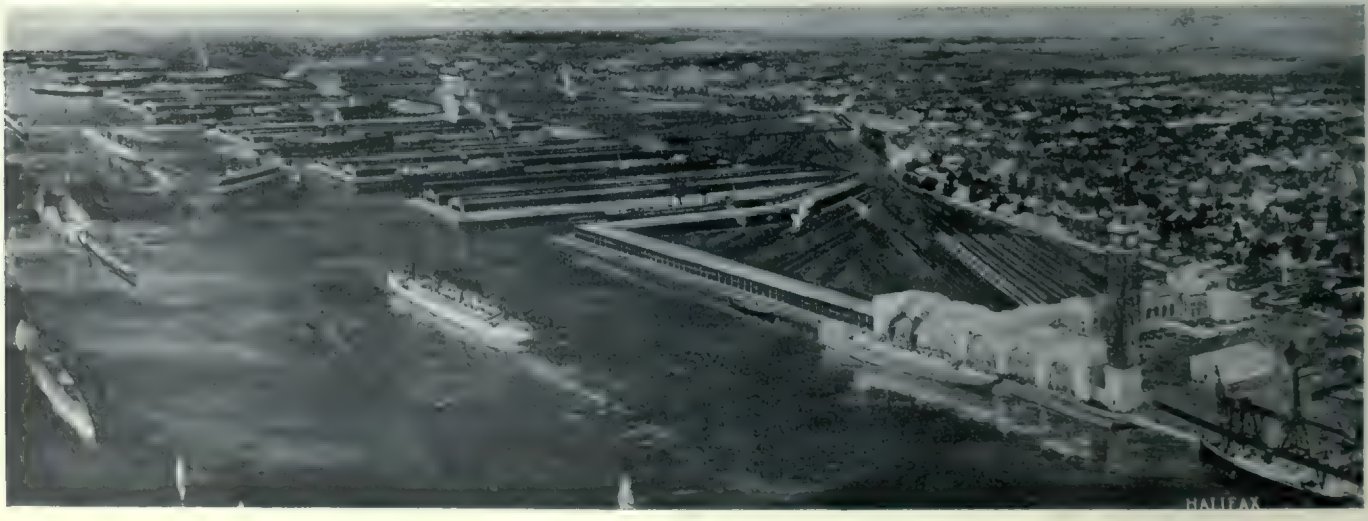
Proposed Ocean and Railway Terminals at Halifax, N. S.

THE general preliminary plans of the ocean and railway terminals at Halifax, prepared by Messrs. Ross and Macdonald, architects, Montreal, and submitted to Mr. F. P. Gutelius, General Manager, Canadian Government railways, show the large scope of this work. They also illustrate the general arrangement for the handling of passengers and freight and the facilities provided for the transferring of passengers, baggage, mail and express to and from railway trains and steamships, as well as for the provisions for the handling of local traffic.

The general scheme consists of a passenger station building in the shape of large letter "T," the foot of the "T" being at the shore end, and the head at the steamship landing stage. The shore end of the building provides accommodation for the local Halifax traffic, and contains ticket offices, baggage and parcel checking rooms, restaurant and lunch room, womens' and mens' retiring rooms with toilets, and provision on the upper floors of the building for office space required by the railway and steamship lines. This portion of the building, which will be known as the Halifax City Station, will face on a plaza located between South and Tobin streets, this plaza extending from Pleasant street east to the front of the station building, about 400 feet in depth. A place for cabs is provided on the north, with access to the baggage checking room and the ticket lobby. Passengers on entering the building will find all the facilities they require for transacting their business, after which they may pass on to the train concourse or train waiting room.

The general plan provides a landing stage approximately 2,000 feet long, which is divided into two parts; a third portion on the north will be set apart for the handling of passengers baggage, mail and express, and the remaining two-thirds devoted to the handling of cargo. It is upon this northerly end of the landing stage that the top portion of the "T"-shaped building is placed.

Passengers disembarking from steamship will enter the building at the second storey level. Passengers' baggage will be discharged at the same level and will be distributed in the usual way for customs examinations. After baggage has been passed by the customs and then checked by the railway company it will be transferred to the floor below by means of chutes or elevators to a distributing baggage room from where it will be routed to cars according to destination. Mails will be discharged directly from the steamship to a distributing mail room in the lower level of the steamship passenger building, from where they will be transferred to cars according to destination. After passengers have landed and have passed



their baggage through the customs they will pass into a booking hall containing ticket offices for the railway and steamship lines. Here passengers may obtain railroad checks for their baggage, secure their tickets and attend to other matters of transportation which they may find necessary. They will then pass into the train concourse or waiting room. This room connects the steamship station with the Halifax City Station and forms the stem of the letter "T" as stated above.

The train concourse is designed for the common use of the Halifax city traffic and the steamship passenger traffic. The floor of this room is placed level with the second storey level of the steamship passenger building, and is also level with the ticket lobby floor of the Halifax City Station. The pasengers platforms on the train shed are placed at a level between the train concourse and the baggage room beneath. All stairways have been eliminated between the train concourse level and the passenger platforms, the passengers reaching the passenger platforms by means of easy inclines. Separate tracking platforms for baggage trucks are provided, and these connect with the baggage room beneath the train concourse by similar inclines but separate from the passenger inclines, thus avoiding all confusion between passengers and baggage.

Adequate provision is made for the large number of immigrants which are expected to come through the Port of Halifax, and detention rooms and offices are provided for the various government officials connected with the immigration work, as well as separate lounge rooms, lunch rooms, sleeping rooms, toilet rooms, etc., for the immigrants themselves. These rooms are not directly connected with the other portions of the station building.

The general arrangements contemplate the erection of a separate power house for the furnishing of heat, light and power for all the buildings connected with the terminal project, a grain elevator for the handling of grain from cars to steamboats and large track provisions for handling of freight to and from the pier sheds.

The construction of the sea walls of the landing stage and the first pier has been let and the work is now under construction. The architects are at present preparing plans for all the work in connection with the buildings to be placed upon these piers. The use of local materials is contemplated as far as possible and practicable, including granite, sandstone, brick and concrete. It is expected that tenders wil be asked for shortly upon the first section of the work, comprising the Halifax City Station and the train concourse up to, but not including, the steamship passenger building. Other parts of the work will be let as fast as progress upon the piers warrants.

Selection and Use of Concreting Materials at the McKeesport Water Softening and Filtration Works

THE water softening and filtration plant at McKeesport, Pa., was placed in operation in October, 1908. The present notes on the selection and use of concreting materials for this plant abstracted by Engineering and Contracting, from a description of the design, construction and operation of the plant prepared by E. C. Trax, chemical engineer, are of interest to all who have occasion to seek watertightness in reinforced concrete construction.

The fundamental principles underlying the design of the reinforced concrete were given careful consideration from both the metal and the concrete standpoint.

Mild steel was adopted, first, because of the possible vibrations due to the operating machinery in the floor system; second, because of the probability of securing a steel of more even structure; third, because low carbon steel is more easily bent, facilitating construction.

The selection of the aggregates for the concrete was also given careful consideration, and a practice was adopted a little out of the customary. The gravel and sand used for the concrete came from the Allegheny River, and it was necessary to screen it before it was used. We required that the gravel range in size from ¼ to 2½ ins. with not more than half of it to pass a 1-in. mesh, and thus insured a more uniform mixture.

Much of the concrete used in the construction was for 6-in. floor slabs, 8-in. tank walls, and for work in general where the percentage of steel was 1.2. There was some criticism from time to time because of the adoption of the large stone, but the mixture took care of the large stone satisfactorily, without voids, due to the proper placing of the concrete around the steel reinforcement. This was watched very closely, and upon the removal of forms, the percentage of honeycomb was less than in other construction inspected from time to time where the maximum size of stone was 1 in. As this practice was more or less unusual, careful inspections were made from time to time to see that the finished concrete was satisfactory. To test for internal voids, several openings were cut through the walls, and in no instance were any found.

Satisfying ourselves in respect to the freedom from honeycombing by using larger stones, we also satisfied ourselves that this proportioning of the aggregates was the best for all practical purposes and convenience of construction. As the general practice recommends a maximum size stone averaging from 1 in. to 1½ ins., tests were therefore made to determine also whether or not the concrete was the best mixture. These tests showed that with stone of the maximum size of 2¼ ins. to 2½ ins., a stronger concrete was procured than with stone of a maximum diameter of 1 in. and 1½ ins. Mechanical analyses were made of the sand and gravel, and from time to time we had to change the mixture due to the slight changes in the proportions of the constituent parts of the gravel. These tests corroborated the findings of W. B. Fuller, published in the Transactions of the Am. Soc. of C. E., in which he shows that for an equal strength of concrete with 1-in. gravel it required 17 per cent more cement than with a maximum size of 2½ ins., and that a concrete with a maximum size of 2½ ins. required 33 per cent less cement than concrete with 1-in. maximum size gravel.

As an example of the success of this method, one of the main circular walls was 24 ft. in height and 13 ins. thick, reinforced with ¾-in. rods both horizontal and vertical. An approximate 1:3:5 mixture was used. It was deposited from the top and fell the entire height. Upon the removing of the forms, no honeycomb surfaces were found. The concrete was mixed quite wet, using as much water as it would hold and great care was taken not to give it an excessive tamping.

Proper consideration was given to the matter of building forms. To build the forms part way up and deposit the concrete at different intervals in the height, required a costly biulding and changing of runways. It also made it absolutely necessary to have a horizontal joint in the concrete whenever the runway was changed. Horizontal joints should be avoided whereever possible; when vertical joints are used keys should be placed in the forms. In no instance did the vertical joints give any trouble whatever. In the few instances where horizontal joints were necessary, great care was taken to wash the old concrete surface thoroughly clean before the placement of fresh concrete. Even after taking this precaution, however, some leakage was found in the horizontal joints. It was finally decided in all instances to build the forms continuous from top to bottom and to place all concrete in the section of the wall so that a complete vertical section could be finished in one day's work. By taking great care in the proper placing and tamping of the concrete, we obtained a wall of quite even texture which gave good results when subjected to the pressure even of clear water.

The method of tamping the concrete was a little contrary to ordinary practice. At first the spade method was used by inserting a sheet of steel about ¼-in. thick between the concrete and the form. This gave a finished surface which did not have any honeycomb, but invariably gave a surface showing a sand deposit which could readily be rubbed off. This form of tamping was finally abandoned and wooden tampers were used with an iron shoe on the end 1 x 6 ins., and instead of inserting this tamper between the concrete and forms, the concrete was pushed against the forms. This prevented the separation of the cement from the sand, and upon the removal of the forms the concrete gave a harder, more metallic appearance. In concluding to construct the forms so as to permit the depositing of concrete from top to bottom in one operation, a question presented itself, whether or not it would be better to build the forms in one piece or in sections. As before stated, the section scheme was finally adopted. The sections averaged 6 ft. high and 8 ft. long. The ribs were cut off to the radii, and the lagging placed on always in a vertical direction; in a few instances the lagging was placed on horizontally or bent to the curvature of the form, but the results were quite unsatisfactory; the tendency to become straight pulled the section out of its true curvature.

The concrete throughout the structure varies in classification and includes groined and plain arches, retaining walls, tanks, cantilever constructions, columns, beams, and floor slabs.

An exceptionally large reinforced concrete reservoir is to be constructed for the city of Dubuque, Ia. It will be circular in shape, 180 ft. internal diameter and 41 ft. deep. It will be of the buttress type, with 32 buttresses. The walls will be 12 inches thick for the top section, 24 inches thick for the bottom section and 16 inches thick in rock. The reinforcement will be round steel bars. In preparing for the reservoir it will be necessary to go down 8 to 15 feet in rock. There also will be a shaft and gate house and a tunnel about 220 feet long in rock. The approximate quantities include 15,000 cu. yds. rock excavation, 30,000 cu. yds. earth excavation, and 2,250 cu. yds. concrete. The reservoir will have a capacity of 7,500,000 gals.

Water Level Indicators and Recorders

THE conservation of water supplies is one of increasing interest in the Dominion, and anything that tends toward the prevention of wastage, or in any way adds to the efficiency of waterworks equipment, should be worth the attention of all those engaged in the design and control of public water supplies.

For upwards of forty years Messrs. Gent & Company, Limited, of Faraday Works, Leicester, Eng., have made a close study of apparatus for indicating or recording water levels in reservoirs, impounding tanks, deep wells, etc. One of their most popular instruments is the "Borough" Water Level Transmitter, shown in Fig. 1. The function of this instrument is to indicate locally, and transmit to a distance when required, the exact height of the water in the reservoir. As will be seen, the instrument is operated by a float, which rises and falls with the varying level of the water. The movement of the float is transmitted to the indicating gear by means of a special chain of accurate pitch, and a weight, which keeps the chain taut over the sprocket wheel. The wheel is geared on to a spindle which operates contacts for every one inch rise and fall of the water. An indicating dial is also connected by gearing to the spindle, showing in feet and inches the exact level of the water. When it is required to transmit this information to a distant point, a receiving indicator, shown in Fig. 2, is fixed in the Engineer's office, pumping station, or wherever the information is required, and this is connected by a single wire and an earth return, to the transmitting instrument. At every inch rise and fall a circuit is completed which moves the hands of the indicator by means of stepping magnets, either backwards or forwards, according to whether the level of the water is

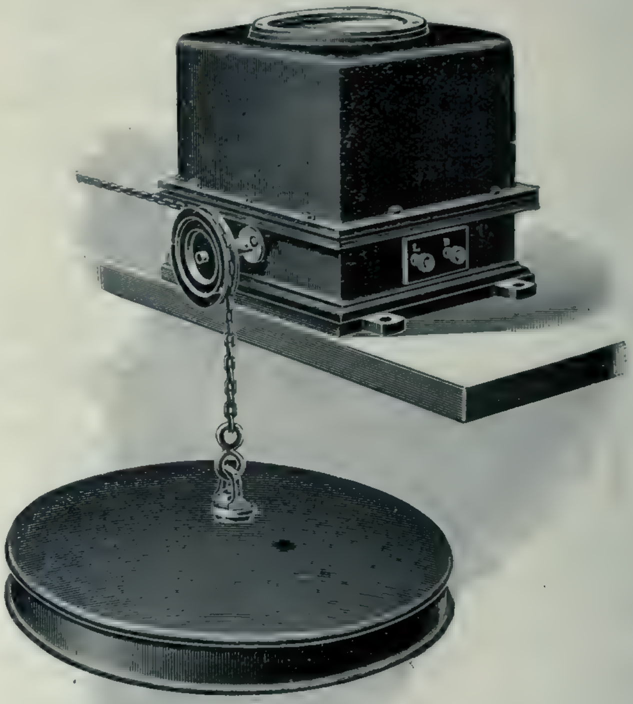


Fig. 1.—"Borough" Water Level Transmitter.

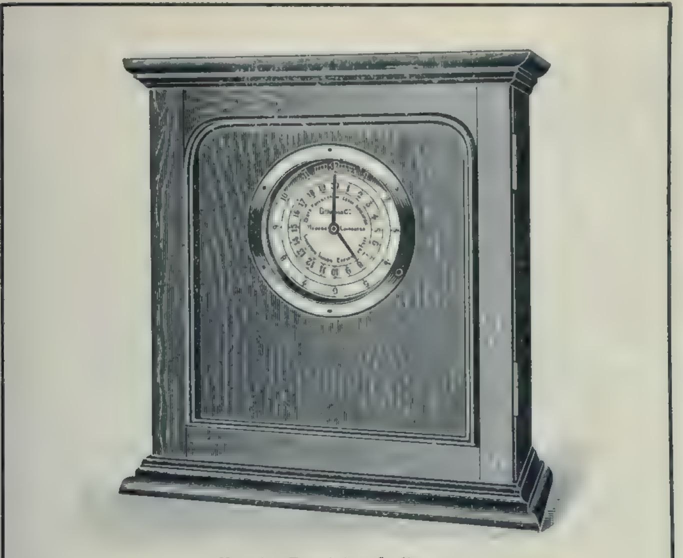


Fig. 2.—Receiving Indicator.

rising or falling. If a permanent record be required, instead of the indicator, a recording instrument is provided, as shown in Fig. 3. This apparatus is actuated in a manner similar to the indicator, and a pen is caused to travel up and down according to the fluctuations of the water level. A chart, fixed to a revolving drum, causes the pen to describe an accurate record of the impulses received. These charts, carefully filed for reference, form a valuable record of statistics as to variations due to weather and sudden demands. Limitations of space prevent our making a more comprehensive survey of the productions of this firm, but their Catalogue 6, on Water Level and Sewage Recorders, contains prices and particulars of a range of instruments for every purpose of gauging and recording, both for Water-Works and Sewage Disposal Plants, and should find a place among the files of every Engineer interested in the building and control of such systems.

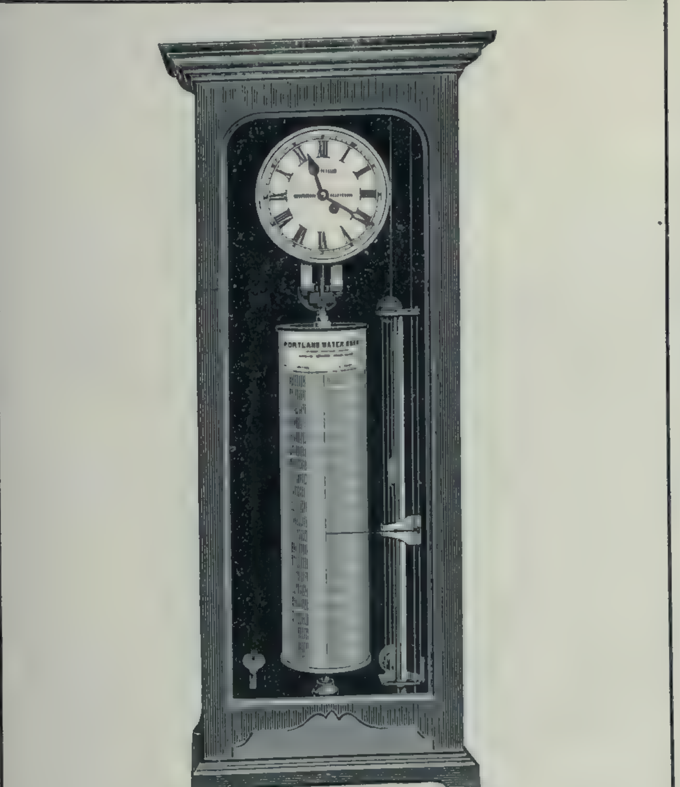


Fig. 3.—Recording Instrument.

Sewer Construction and Sewage Treatment

In discussing the subject of sewage disposal in Philadelphia recently, George S. Webster, Chief of the Bureau of Surveys, called attention to the desirability of constructing sewers with smooth interiors and keeping them clean and inoffensive for the purpose of insuring that the sewage which reaches the station will not contain products of putrefaction originating in deposits anywhere in the sewerage system. This applies especially to deposits in depressions or irregularities in the sewers and directs attention to the importance of using materials and methods which will insure against roughness of material or depressions in grade which will cause the pooling of sewage or the formation of deposits which are not carried along by the ordinary flow of two or three feet per second. Engineers are already familiar with the desirability of such construction in order to avoid objectionable odors, but with the increasing number of treatment plants throughout the country, and especially of sprinkling filters where the spraying gives abundant opportunity for the escape of gases, it is especially important that the sewage reach the plant in as fresh and inoffensive a condition as possible, and this adds another and very important argument towards using in every case materials which will give a smooth interior, and for care in workmanship which will insure an absolutely uniform gradient.

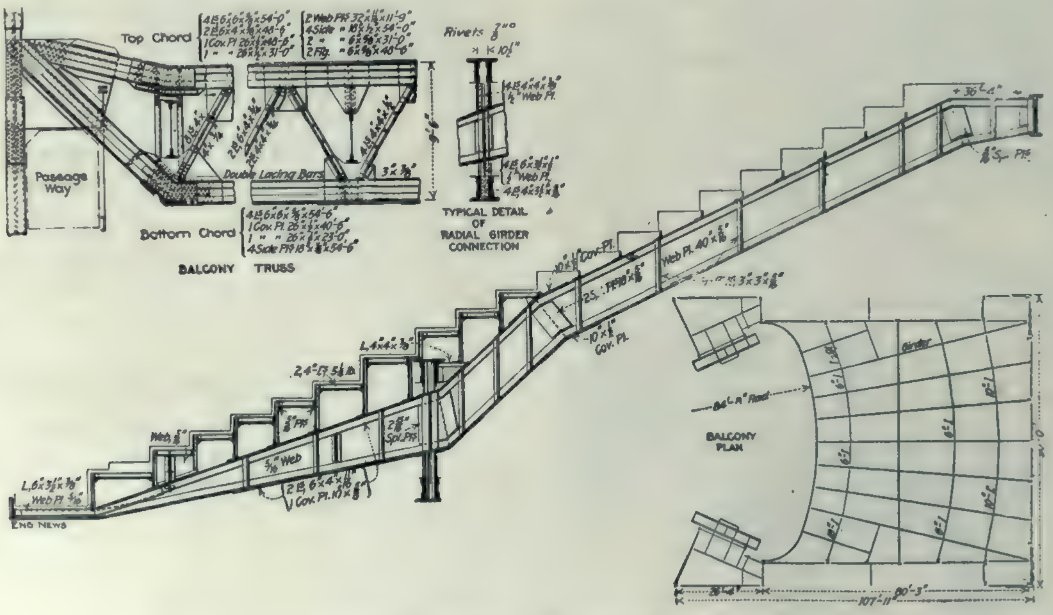
Another Aspect of Ventilation

An interesting aspect of the science of ventilation is dealt with in a recent article in the Times. Some little while ago, we are told, a number of students of London Hospital entered a cabinet, which was then closed. In the course of half an hour the atmosphere became oppressive. No fresh air was admitted, but an electric fan was started inside the cabinet. The movement of the air caused by the fan is said to have entirely removed this sense of oppression. Hitherto, we learn, an atmosphere was considered healthy or unhealthy according to the constituents of which it was formed, but to-day we know that the essential point is to keep the air in motion. From this the moral is drawn that the problem of ventilation is the avoidance of stagnation of air. Stagnation, of course, whether of air or of water, of mind or of body, is inimical to health; but the problem of ventilation has other factors. The experiment recorded is valuable as far as it goes, but it is a pity it did not go further. No doubt the immediate effect of the fan was as described, but it would have been still more valuable to know how long that effect could be maintained without the admission of fresh air. It is just possible that after the lapse of an hour or two the victims of this experiment would revert to their former belief in the importance of the chemical constituents of the atmosphere, and be disposed to think a little more oxygen, however, stagnant, preferable to too much carbonic acid, however violently it might be agitated by an electric fan. At any rate, there seems no proof that movement alone will keep pure for any length of time the air of a crowded room.

Balcony Framing, McBride Theatre, Victoria, B. C.

SOME interesting balcony-framing features are found in the McBride Theatre, recently built in Victoria, B.C., by the Victoria Opera House Company, Limited. Following the general modern practice, the balcony is supported by a transverse truss, eliminating columns in the clear space of the auditorium below; radial cantilever girders resting on this truss and anchored in the back wall, support the balcony floor-beams. The radial girders are of unusually long overhang—up to 31 ft. at the maximum—and because of the mezzanine foyer below, they are of peculiar shape.

The theatre building is 90 ft. wide by 150 ft. long. The small-scale plan in the drawing herewith shows the arrangement of the balcony framing. The balcony-truss columns are set a short distance inside the side walls. The truss is 74 ft. 10 in. long c. to c. of end columns; its effective depth is about 8½ ft. There are seven radial girders of full length to back wall, and two auxiliary radials so located that they could not receive wall anchorage. The back end of each auxiliary radial is supported and anchored by a short loading girder in the plant of the floor-beams, while the middle of the radial is suspended from an 18-in. I-beam set just above the regular floor-beams and concealed under the second step of the balcony.



Balcony-truss and cantilever girders on McBride theatre.

The roof column just back of the boxes has the balcony fascia girder attached to it, but is stiffened in both directions, transversely by a beam connecting it with the wall column and longitudinally by a 15-in. floor-beam. The fascia girder is a light 16-in. plate-girder.

The Warren-system web of the balcony truss gives room for passing the radial girder between the chords, without interfering with the truss members. It is fastened by shoe and stay-gusset connections to the lower and upper chords. This position of the radial girder brings it considerably below the stepping of the balcony. In consequence, back to the balcony truss, where the mezzanine foyer required increased clearance, the line of the radial girder is offset upward, producing a reversed bend in the outline of the girder. The splices at the angles do not involve any particular complication.

The radial girders weigh about 6½ tons each. They were shipped and erected entire.

The balcony truss, whose makeup will be clear from the drawing, has its end panels sloped up, which gives it a sagging shape. Inclined passage-way (in place of steps) from the street level to the balcony cross under the balcony truss at the ends at about the level of the bottom chord, and the headroom needed for these passage-ways required the truss to be sloped up. Since the balcony floor is a curved surface, the clearance over the truss increases at the sides sufficiently to give ample room for the sloped panel.

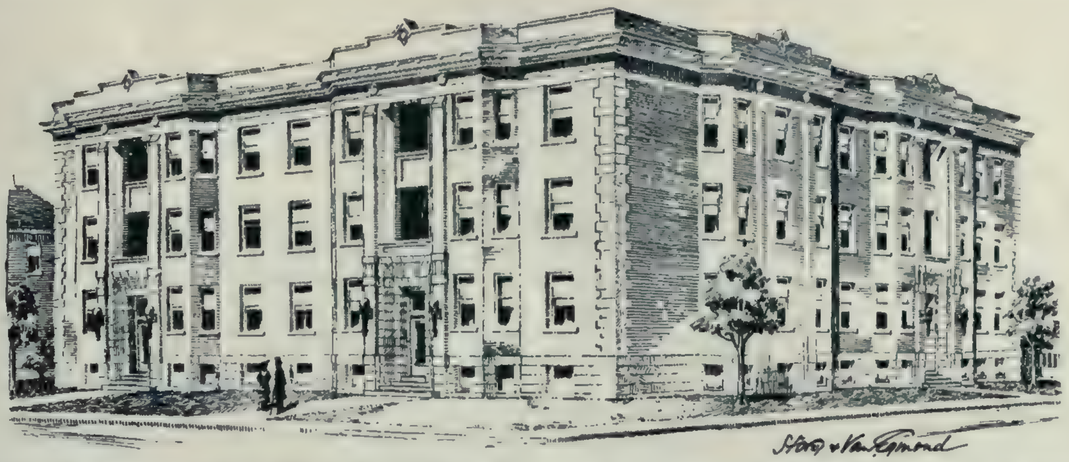
The total weight of the balcony truss is 51 tons. The truss was assembled in the shop and all connection holes reamed to match, then knocked down, slipped in separate pieces, and erected in the field.

The roof and floors throughout the building are reinforced-concrete slabs with triangle-mesh reinforcing.

The McBride Theatre cost $400,000. It is considered to be one of the finest buildings of its kind on the Pacific Coast. The steel framework has a total weight of 500 tons. The foundations are concrete piers through mud to bedrock, 20 to 50 ft. below sidewalk. They are constructed by sinking open cylinders and filling them with concrete after reaching rock.

Rochfort & Sankey, of Victoria, B.C., were architects for the theatre, and H. W. Bittman, of Seattle, Wash., was structural engineer. Pinney & McLellan were the general contractors, while E. E. Davis & Company erected the steelwork.

In the year 1913, according to a report recently issued by the American Wood Preservers' Association in co-operation with the U. S. Forest Service, ninety-three wood-preserving plants consumed more than 108,000,000 gal. of creosote oil, 26,000,000 lb. of dry zinc chloride and nearly 4,000,000 gal. of other liquid preservatives. With these the plants treated more than 153,000,000 cu. ft. of timber, or about 23 per cent more than in 1912.



Apartment building to be erected at Regina for Mr. J. S. Bartleman. Estimated cost, $80,000. Architects, Messrs. Storey & Van Egmond.

Constructional News from the Saskatchewan Capital

Correspondence of the Contract Record

REGINA, July 17, 1914.—The apartment block is becoming more and more general in Western Canada. In Regina, numerous high-class apartments have been erected during the last few years, and while apartment rents are in advance of house rent, there are always tenants to be found. One of the latest apartments undertaken is that being erected by J. S. Bartleman at a cost of $80,000. The building will be of fireproof construction throughout, with columns, beams and floors of reinforced concrete, solid brick walls and hollow tile partitions. The finish will be of oak and floors of maple. In each suite there will be a cut stone fireplace. The balconies will be located both on the front side and the rear. The rear balconies will be of concrete with iron service stairs. The exterior will be of light grey pressed brick with cut stone trimmings and entrances of cut stone. A feature of this apartment is that the rooms are outside rooms. The construction of the building is proceeding rapidly. Messrs. Storey & Van Egmond, of Regina, are the architects.

The construction of the Campbell, Wilson & Strathdee warehouse on Dewdney street is proceeding apace. This building, which is situated in the very heart of the industrial section, will be five storeys in height and 150 ft. by 125 ft. in dimensions. It is estimated that the cost will be in the neighborhood of $80,000. The Frid Lewis Company, who recently opened an office in Regina, were awarded the contract for this building and are rushing it through to completion.

The revised estimates for local improvement expenditures at Regina last year call for an aggregate expenditure

New warehouse under construction at Regina for Messrs. Campbell, Wilson & Strathdee. Estimated cost, $80,000. Messrs. Frid-Lewis Company, contractors.

of $2,337,165. Some of the larger items are: pavements, $146,906; sewage disposal works and sewer connections, $71,606; domestic sewers, $74,000; storm sewers, $82,614; waterworks, $250,000; water mains, $76,592; power plant and electric light distribution, $380,000; General Hospital, $111,084; north west fire-hall, $20,000; sidewalks, $18,570; completion of Broad street subway, $18,000; parks, $21,460; Collegiate Institute, $36,000; street railway, $51,262; Hamilton street bridge, $35,000. It is probable that the city will make arrangements for the issue of $2,000,000 treasury notes within the immediate future.

The Coste-McAuley Company has filed on about 80,000 acres of oil and gas lands northwest of Swift Current. This company will bore for gas without delay. As soon as they locate a gas flow they will lay pipe-lines from these fields to Regina in order to fulfil their cotnract with the city.

An overhead bridge across the Canadian Pacific Railway tracks at Hamilton street, Regina, will be erected within the near future. Chairman Drayton, of the Railway Commission, when in Regina, ordered City Engineer McArthur and Engineer McIntosh of the Canadian Pacific Railway to select a suitable plan for such a bridge. The engineers could not agree on matters of detail, and each will prepare a plan which will be forwarded to the Railway Commission.

Personal Mention

Mr. Lucius E. Allen, C.E., Consulting Engineer of Belleville, Ont., is at present on a trip to Europe with the object of investigating Continental methods and materials in connection with the construction of good roads and pavements.

A Contributor to This Issue

Mr. J. L. Busfield, who is now in charge of the Department of Design of the Mount Royal Tunnel & Terminal Company, Limited (Mackenzie, Mann & Company), has contributed a number of interesting technical articles to the Contract Record and Engineering Review, and other publications, and he is the author of an article on System published in this issue. Educated at Dulwich College (London, Eng.), and at the Central Technical College, he obtained the B.Sc. degree (in Engineering) with honors at London University in 1907, and in the same year was made an Associate of the City and Guilds Institute. Coming to Canada in the same year, he was made Junior Assistant to the Resident Engineer on the Eastern Division of the Grand Trunk Railway, and became Chief Assistant two year later. At that time the Eastern Division of the Grand Trunk Railway comprised the Montreal-Toronto main line, the Montreal-Portland line, the Richmond-Quebec line, and all lines east and south of Montreal. In 1912 he became identified with the Mount Royal tunnel and terminal construction as Assistant Engineer in charge of the Survey and Alignment Party of the Eastern Division. He succeeded to his present office of Assistant Engineer in charge of the Department of Design only this year. Recently he was sent to New York as one of a committee of three to study terminals, track lay-outs and construction on the principal railways in that city. He is an Associate Member of the Institution of Civil Engineers (Great Britain) and of the Canadian Society of Civil Engineers.

Mr. J. L. Busfield, Montreal.

Mr. W. J. Curle, Superintendent of Brockville, Westport & North-Western Railway, a subsidiary branch of the Canadian Northern Railway, has been notified of his appointment as Superintendent of the Canadian Northern between Toronto and Port Arthur.

Mr. H. T. Crosbie, Town Engineer of Yorkton, Sask., read a paper at a recent municipal convention in Moose Jaw on "Engineering advice to villages about to enter the town estate." He discussed in an interesting way the subject of water supply, sewerage, electric light, sidewalks and boulevards, and town planning.

Notice of the following elections to membership in the American Society of Civil Engineers has been received:—Elected Member: Mr. G. F. Palmer, Resident Engineer for Messrs. Norton, Griffith & Company, Limited, St. John, N.B. Elected Associate Member: Mr. W. E. Joyce, Engineer-in-Charge of Structural Design for the Mount Royal Tunnel & Terminal Company, Montreal; Mr. Allen van Rensselaer, with Mr. Wynne Meredith, of Messrs. Sanderson & Porter, Victoria, B.C. Transferred from Associate Member to Member: Mr. G. P. Hawley, Resident Engineer, The Cedars Rapids Manufacturing & Power Company, Cedars, Que.; Mr. Harry Sidenius, Resident Engineer, C. P. R., Department of Natural Resources, Calgary, Alta. Transferred from Junior to Associate Member: Mr. F. W. Dorrance, Principal Assistant Engineer, Montreal Filtration Works, Montreal; Mr. L. W. Klingner, Engineer to the Dominion Construction Company of Toronto, Belleville, Ont.

The International Irrigation Congress will hold its 21st annual meeting at Calgary, Alta., October 5-9. Mr. Richard W. Young, of Salt Lake City, Utah, is the President, and Mr. Arthur Hooker, Calgary, Secretary.

A party of fourteen Canadian municipal engineers and officials visited Detroit and Wayne County, Mich., recently, to inspect the comprehensive concrete road improvement system carried on there. The party was accompanied by Mr. L. S. Bruner, of the Canada Cement Company, Limited.

The Montreal Builders' Exchange have been invited by Mr. D. Norman MacVicar, chairman of the Quantity Surveying Committee of the Province of Quebec Architects' Association, to co-operate on the question of quantity surveying. The Architects' Association desire to obtain the views of contractors, who are naturally as much interested in the subject as are the architects. A committee of the Exchange has therefore been appointed to go into the entire question with the architects.

Preliminary plans for constructing a steel and concrete bridge over Johnson Creek, B.C., at an estimated cost of $450,000, have been approved. The Foundation Company of Vancouver has secured the contract for constructing a steel and concrete bridge over the Second Narrows at Vancouver, B.C., at an expenditure of $2,000,000.

MAINLY CONSTRUCTIONAL

EAST and WEST — FROM COAST to COAST

EASTERN CANADA

The ratepayers of Hamilton will be asked to vote next month on a by-law to raise the sum of $175,000 for sewerage work east of Ottawa street.

Stratford, Ont., is to have a new garbage incinerator. The site upon which the plant will be constructed has been decided upon, and it is expected that the contract will be let shortly.

A contract award of outstanding interest is that for Section 3 of the Trent Canal (Severn Division) to Messrs. Randolph MacDonald Company, Toronto, at a figure slightly in excess of $900,000.

A permit has been issued in Toronto for the construction of a commercial school on Dewson street, at an estimated outlay of $250,000. The building will be completed in a year and a half.

The announcement is made from Montreal that the Grand Trunk Pacific Railway is now conveying passengers over an all-rail route from Fort William, Ont., to Prince George, B.C., a distance of 1,729 miles.

The permanent paving work carried out so far this year in London, Ont., is over half what it has been in the last ten years, according to a list of permanent pavements prepared by the city engineering department.

At Toronto, a site has been purchased on Carlaw avenue for the erection of a new school building estimated to cost $200,000. The Board of Education (Secretary-Treasurer, Mr. W. C. Wilkinson) are the principals in the project.

The City Council of Hull, Que., has decided to authorize the Mayor to place an order with the Canada Iron Corporation, Limited, Montreal, for a supply of iron pipe to be used in the extension of the waterworks system throughout the city.

The contract for the construction of St. Michael's Church, Montreal, a description of which was given in our last issue, has been let to the Atlas Construction Company. Messrs. Beaugrand-Champagne and Chenevert are the architects.

A report from Chatham, Ont., states that the Grand Trunk and Canadian Pacific Railways have been notified by the City Clerk to improve their railway crossings, failing which legal steps will be taken by the city to secure compulsory powers.

The contract for a new church for the R. C. Parish of Ville Emard, Montreal, has been awarded to Mr. H. Tessier, general contractor, of that city. The estimated cost of the building is $150,000. Mr. A. Bergeron, of Longue Pointe, is the architect.

At Fort William, Ont., foundation work is in progress on the Customs House, which is being erected at a cost of $175,000. The building is three storeys high, 100 x 80 feet in dimensions, of reinforced concrete, steel and brick construction. The general contractor is M. H. Braden.

Messrs. John Quinlan & Company, of Montreal, are the general contractors for an assembly hall which is to be erected in that city at a cost of $135,000. The building is to be of steel, reinforced concrete and stone construction. Mr. J. P. Hynes is the architect and St. Patrick's Parish is promoting the enterprise.

The Port Dover Brick & Tile Works were destroyed by fire recently, and a loss of $20,000 sustained. The fire is believed to have been the work of an incendiary, as the plant was operated entirely by gas and the latter had been turned off 36 hours before the outbreak. It is stated that the plant was not insured.

The "Cyclone," one of the two large hydraulic dredges under construction for harbor development work, was launched from the yards of the Polson Iron Works, Toronto, on July 13. Both dredges are being built for the Canadian Stewart Construction Company, who have the contract for the harbor front development work.

The foundation work has been completed for the Church of St. Francis d'Assissi, which is to be erected at Ottawa at an estimated cost of $156,000. The building will be of stone construction, 67 feet by 241 feet in dimensions. The architect is Mr. Charles Brodeur, of Hull, Que., and the general contractors are Messrs. Noel and Monette.

Sir Adam Beck, addressing a meeting at Bridgeport, Ont., a few days ago, made the interesting announcement that the Hydro Commission was taking steps to develop power along the French River between Georgian Bay and Lake Nipissing, and had recently received an order for 10,000 h.p. from the British-Canadian Nickel Corporation, which proposes to establish plants along the river.

The Board of Trade has announced that construction of the government wharf at Courtenay Bay will be started in May, 1915. In connection with the dredging operations the Norton-Griffiths Dredging Company have obtained a self-propelled steam hopper scow. Owing to the existence of rock on the suggested site it has been decided to begin construction three hundred feet further up towards the head of the Bay in the erection of wharves Nos. 1 and 2.

In addition to the Union Station at Toronto, the P. Lyall & Sons Construction Company, Montreal, have just secured other large contracts. The most important of these is the customs examining warehouse at Ottawa, originally let to the Simcoe Construction Company. The price is $1,173,000. The Lyall Company have obtained the contract for the Excelsior Life Insurance building, Toronto, $300,000, and the detention house, for third class passengers at Grosse Ile, P.Q., $48,000.

A new type of automatic signal has been put into service for the first time on the Grand Trunk line for handling traffic across the Victoria Jubilee Bridge on the St. Lawrence River. The apparatus is the alternating current, three position, semaphore type of signal and replaces the signal erected in 1902. The apparatus was installed by the Union Switch & Signal Company of Philadelphia, under the superintendence of Mr. R. F. Morkill, Signal Engineer of the G. T. R., and B. Wheelwright, Signal Inspector.

The Board of Control of Hamilton, Ont., are contemplating the submission of a by-law to the ratepayers next January, regarding the proposal to purchase a stone quarry and also with reference to an offer made by the Canada Crushed Stone Corporation to supply the city with crushed stone at from 85c to 90c per ton, on condition that a contract extending over five or ten years was made. The city engineer estimated the cost of the taking over of the Dunlop quarry at $122,000, or $47,000 more than the original estimate.

Work is progressing steadily on the construction of the new Quebec bridge at Neilsonville, Que. The firm of M. B. & J. T. Davis have completed the construction of the granite piers, eight in number. The main piers are ninety feet below water level and twenty-eight feet above, making a total height of 118 feet. The anchor piers are each 160 feet high with dimensions of seventy-five by thirty feet at the bottom. It is expected that Messrs. Davis will complete their part of the contract by the end of this fall. The main portion of the structure, the actual building of the bridge, is in the hands of the St. Lawrence Bridge Works Company. They are making rapid progress in arranging a special plant in the vicinity of the work. This includes an overhead crane of seventy-five tons capacity, operated by electricity and supported on steel pillars. The approach spans to the bridge, with the exception of the sidewalks, have already been completed, while the anchor arms are at present being built. The bridge proper is the cantilever and suspended centre-span type, the distance between the centres of the piers being 1,800 feet. The suspended span is 640 feet long, which is believed to be the longest centre span in the world. The length of each of the anchor arms is 515 feet, while the total length of the bridge, including approaches, will be 3,239 feet. The height from high water level to the top of the main posts is 344 feet and the clear height from the high water level to the suspended span is 150 feet. The centre span is to be constructed entirely of nickel steel to conserve weight. Each of the cantilevers will be erected as an entirely separate structure with its individual erection equipment.

WESTERN CANADA

The Vanderhoof Power Company, Limited, Victoria, B.C., have filed plans for construction of two dams (capacity 10,000 acre feet) at Fort Fraser, B.C.

The rural municipality of Assiniboia is having plans prepared for a system of sewerage and waterworks estimated to cost $500,000. The secretary of the municipality is Mr. Frank Ness, Kirkfield Park P.O., Man.

Tenders for the erection of a post-office at Prince Rupert, B.C., estimated to cost $100,000, have been extended to August 1. The building is to be four storeys and basement, of reinforced concrete, terra cotta and brick veneer construction.

The Morrison Nail and Iron Works, of Vancouver and New Westminster, are seeking a site in the latter centre on which to erect a factory with trackage facilities. They intend disposing of their property on Lulu Island and transferring the plant to New Westminster.

Plans are almost completed for the new departmental building to be erected at Calgary for the Dominion Government. The building is to be partly constructed with material taken from the old post office lately torn down, and will occupy a site at the corner of 6th Avenue and 4th Street west. The plans have been prepared in the office of Mr. Leo. Durrell.

The Saanich, B.C., Council has decided to prepare a bylaw immediately and submit it to the ratepayers in connection with the projected introduction of a water supply. The preliminary work in connection with the scheme has occupied the attention of the engineering staff for some time and it is probable that the Council will secure the necessary mandate to proceed with the work.

The Burrard Engineering Company, of Vancouver, have started operations on the contract for the laying of a steel pressure pipe line in connection with the Sooke Lake waterworks system between Humpback Reservoir and Victoria. About 400 or 500 feet of concrete and steel pipe will be laid daily by the gangs of the respective contractors, including the Pacific Lock Joint Pipe Company.

The city of Victoria, B.C., is being asked to vote on a by-law to expend approximately $400,000 towards the cost of the proposed Johnson street bridge, the entire cost of which is estimated at $750,000. Of this amount the Provincial Government will contribute $175,000; the C. P. R. $80,000, and the British Columbia Electric Company $50,000. At present it is not quite clear whether the type of structure to be erected will be of the swing or bascule type.

Building operations at Medicine Hat, Alta., have shown a satisfactory advance during the first six months of 1914, as compared with the corresponding period last year. The figures for the first half of the present year are $1,626,085 as against $1,363,225, an increase of $262,860. The increase is due largely to the unusual number of big buildings to be erected this year, while at the same time there is no apparent falling off in the number of private residences and small stores.

The Greater Winnipeg Water District Administrative Board contemplate the calling of separate tenders shortly for the construction of an aqueduct and intake from Indian Bay to Deacon. The whole undertaking involves the expenditure of about $8,729,000 and the portion dealing with the construction of the aqueduct is to be divided into five sections, exclusive of the intake, which is estimated to cost $50,000. Tenders for the works will close at noon on Saturday, September 19.

The excavating work for the new stores and offices which are to be erected at Edmonton, Alta., by Messrs. Adams Bros., at a cost of $150,000, has been completed and tenders for the superstructure are about to be called. The architects are Messrs. Barnes & Gibbs, Imperial Bank Building, Edmonton. The System M structural steel work is to be carried out by the Canadian Standard Concrete Steel Company of Winnipeg. The building will be 150 x 50 feet in dimensions and will contain four storeys and basement. The construction will be of reinforced concrete, brick and steel.

The Jeffrey Manufacturing Company, manufacturers of electric locomotives and conveying machinery, announce a change in the management of their Canadian branch, located at No. 55 Cote Street, Montreal. Mr. M. W. Sherwood, who for a number of years was assistant sales manager at the Columbus, Ohio, factory, has been placed in charge of their Montreal office, taking the place of Mr. H. W. Scott, who has resigned to establish for himself an engineering and contracting business. In the four years in which Mr. Scott has been in charge of this office, he has made a host of friends and all will wish him success in his new undertaking.

According to the engineer's statistics, the weight of granite blocks laid since the commencement of operations on the construction of the Ogden Point breakwater, B.C., amounts to 3,677 tons. Throughout June practically 2,000 tons of granite were placed in position by the divers. The work is carried out by means of a powerful steam crane operated from a big scow, and all the granite being used in the breakwater construction is procured from Hardy Island. The work is so far advanced by the contractors, Sir John Jackson, Limited, that operations will be started this month on the concrete work forming the superstructure of the great sea wall. The Associated Cement Company, of Bamberton, who are the contractors for the cement, have delivered 1,250 barrels on the site. Before use it is to undergo a twenty-eight-day test. The total amount of rubble dumped to the end of June is placed at 373,608 tons. An idea of the importance of the work can be gained when it is stated that the width of the base of the foundations is 200 feet, tapering to a height of 72 feet.

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Alphabetical Index of Advertisers
Page 18

Vol. 28 **July 29, 1914** **No. 30**

Principal Contents

Vancouver City Council's Unsavory Competition 947
Emergency Water Supply System for Montreal 948-53
By Frederick E. Field
Hydrated Lime in Concrete Road Surfaces 953-4
By Robert S. Edwards
Training Men in the Contractor's Organization 954-6
The Results of Hypo-chlorite Treatment of Water 956
Making Railroad Fill from Pontoon Bridge 957
A New Concrete Piling 958
The Standardization of Horizontal Tubular Boilers.. 959-60
The Construction of Creosoted Wood Block Pavements 960-1
By R. S. Manley
Constructional Details in Their Relation to Lighting Efficiency 961-3
Terra-Cotta in Building Construction 963-5
By H. L. Fitzsimmons
Hydraulic Fill Levees on the Mississippi 965-6
An Interesting Discussion 966
Drainage and Sanitary Fittings in Canada 966-8
By F. J. Osborne Smith
Design and Construction of Intercepting Sewers with Special Reference to Minimizing Infiltration ... 968-9
Sand and Coarse Material and Proportioning Concrete 969-70
Status and Prospects of the Steel Trade in Canada ... 970
Biographical—Mr. Wm. Lyall, Montreal 971
Obituary—Dean Galbraith 972
Personal Mention 972
Constructional and Industrial News 973-6

Vancouver City Council's Unsavory Competition

MUCH has been said about the abuses of professional competitions and apparently much remains to be said. Objections have been brought forward, one by one, in many instances that we can call to mind, but it has remained for the city of Vancouver to provide, in one flagrant example, an embodiment of all the evils attendant upon engineering and architectural contests.

Last spring the Vancouver City Council invited competitive plans for the new causeway and sea-wall at Coal Harbor. This esplanade, leading to Stanley Park, affords a particularly attractive opportunity for the designer, the work suggesting a rare combination of the aesthetic with structural efficiency, and it is small wonder that the invitation to submit designs met with a generous response and that plans were received from twenty-three designers.

In the conditions sent out to the various competing engineers, the competitors were asked to provide sufficient details to enable the City Engineer, Mr. Fellowes, to check over the designs in regard to the strength and stability of the proposed work. It was stipulated that the designs should conform in line and grade with the plans supplied by the City Engineer. Competitors were requested to withhold their names from the plans, specifications and estimate. A clause was inserted to the effect that disregard of the conditions would entail disqualification. The rate at which the successful engineer would be recompensed was stipulated carefully.

These conditions are sufficient to show that the competition was in the palm of the City Engineer. With what amazement, then, do we now learn that the plans of the City Engineer have been approved and accepted by the Vancouver City Council—and this in the face of strenuous objection on the part of professional bodies in such high standing as the Canadian Society of Civil Engineers and the Architectural Institute of British Columbia, to say nothing of a united protest from the twenty-three competitors. From the evidence offering—and full details have been furnished by the Vancouver Office of this journal—we do not hesitate to commit ourselves unequivocally in condemnation of the fact that the City Engineer compiled the regulations governing the competition, assumed the part of technical expert in judging the designs and finally became a competitor, thereby, in the last-named regard, violating one of the essential parts of the competition.

It is inconceivable that any recognized body of men having a reputation to sustain should ruthlessly set aside the efforts of twenty-three designers after inviting them to compete and affording their own engineer the opportunity to get pointers from the designs. We do not allege that the City Engineer of Vancouver lent himself to such malpractice, but we do contend that the opportunity to do so was afforded him.

In defence of his own work and of the Council's selection, the Vancouver City Engineer urges that the modified plans submitted by him were conceived and prepared before he had examined the competitive designs, and that he had no previous knowledge of their structural arrangements. In this regard Mr. Fellowes' word must be accepted. But the explanation, such as it is, does not provide any excuse for the dishonest principle upon which the whole scheme of the competition is based. To allow a score of men to compete and incur expenses which might, in the sum total, well run into something like $15,000 to $20,000, is a piece of unconscionable filching (on the part of a city corporation) which in another guise might well come within the pale of the law. Such a violation of the conditions under which the competition was understood to have been conducted is a breach of confidence which one cannot extenuate. An experience of this kind is enough to set the faces of professional men throughout the whole country against competitions in general and particularly against work of any kind with which the city of Vancouver is even remotely connected.

The Vancouver Council called for a competition, and the conditions of that competition, stated or unstated, demanded that the plans should be submitted to a fully qualified and independent tribunal, so that the best plan would be selected and the winner at least have the honor of being placed first. The awards should have been made on the merits of the designs which conformed to the conditions set forth. After the award had been announced, the designer could have made any desired modifications upon a consultation with the City Engineer.

Seldom if ever does a contest pass without producing a few disgruntled competitors, but the Vancouver competition is in a class by itself. All the competitors, all the professional bodies, all honest men, apparently, are united in condemning the unsavory policy of the Vancouver Council. And all the protests are of no avail. The competition would appear to have been arranged merely for the sake of providing a secondary check upon plans which it had already been decided to accept.

This competition provides another instance of the need for the closer control of such contests by professional bodies. We cannot help thinking that in this instance the Canadian Society of Civil Engineers—collaborating, perhaps, with the Architectural Institute of British Columbia—should have appointed an expert to make a close scrutiny of the conditions by which the competition was hedged in. Had this been done, the loophole by which this injustice has been made possible would have been discovered. It should be compulsory for municipal bodies to submit conditions of competitions for engineering work to the Canadian Society of Civil Engineers. Without directing and controlling such, the latter body is not fulfilling one of its most important functions.

There can hardly be any redress. In all probability the united efforts of the twenty-three competitors—their brains, their labor, their time, their plans and their protests—will be unavailing. One can only sympathize with the hoodwinked "23" and offer them the same advice about competitions as Punch offered about matrimonial ventures—"don't."

Emergency Water Supply System for Montreal

Specially contributed by Frederick E. Field, Engineer in Charge

THE city of Montreal receives its water supply from the St. Lawrence River. An 8½-ft. concrete conduit laid in the north bank of the aqueduct brings the water from a point above the Lachine Rapids to the low level pumping station, a distance of about five miles.

On the night of December 25, 1913, this 8½-ft. conduit failed at a point where the widening of the aqueduct was under construction, and for eight days the city was practically without water, either for domestic and commercial uses or for fire protection.

The nature of the break in the conduit, the temporary repairs made, and the report of the Board of Engineers appointed to investigate this matter, have already been detailed in this journal and need no further comment.

Emergency Supply

On account of the crippling of the water supply occasioned by the break of December 25th, the city officials deemed it necessary to provide a secondary source of supply immediately, and on January 2, 1914, it was decided to construct an emergency water supply system from the Lachine Canal to the existing suction well at the low level pumping station and to have the work rushed day and night until completed.

The purpose of the new emergency supply system is two-fold: (1) to safeguard the city from a recurrence of a failure in its water supply while the work of widening the aqueduct is in progress; (2) to provide a permanent and ample secondary source of supply to be used in the event of any great conflagration or other emergency.

The general layout of the system is shown in Fig. 1. It comprises an intake chamber on the canal bank, about 1,300 feet of 8-ft. rivetted steel pipe encased in concrete, and a low lift pumping station adjacent to and connected with the existing suction well of the low level pumping station. The pipe-line crosses under two railroads and St. Patrick Street and over the River St. Pierre.

These crossings, together with the connections into the Lachine Canal and the existing suction well, provided interesting constructional problems, some of which will be described later in greater detail.

The capacity of this emergency supply system under the most unfavorable conditions—i.e., when the water in the canal is low and pumping is required—is 80 million Imperial gallons a day. Under normal conditions a greater supply of water may be obtained by gravity.

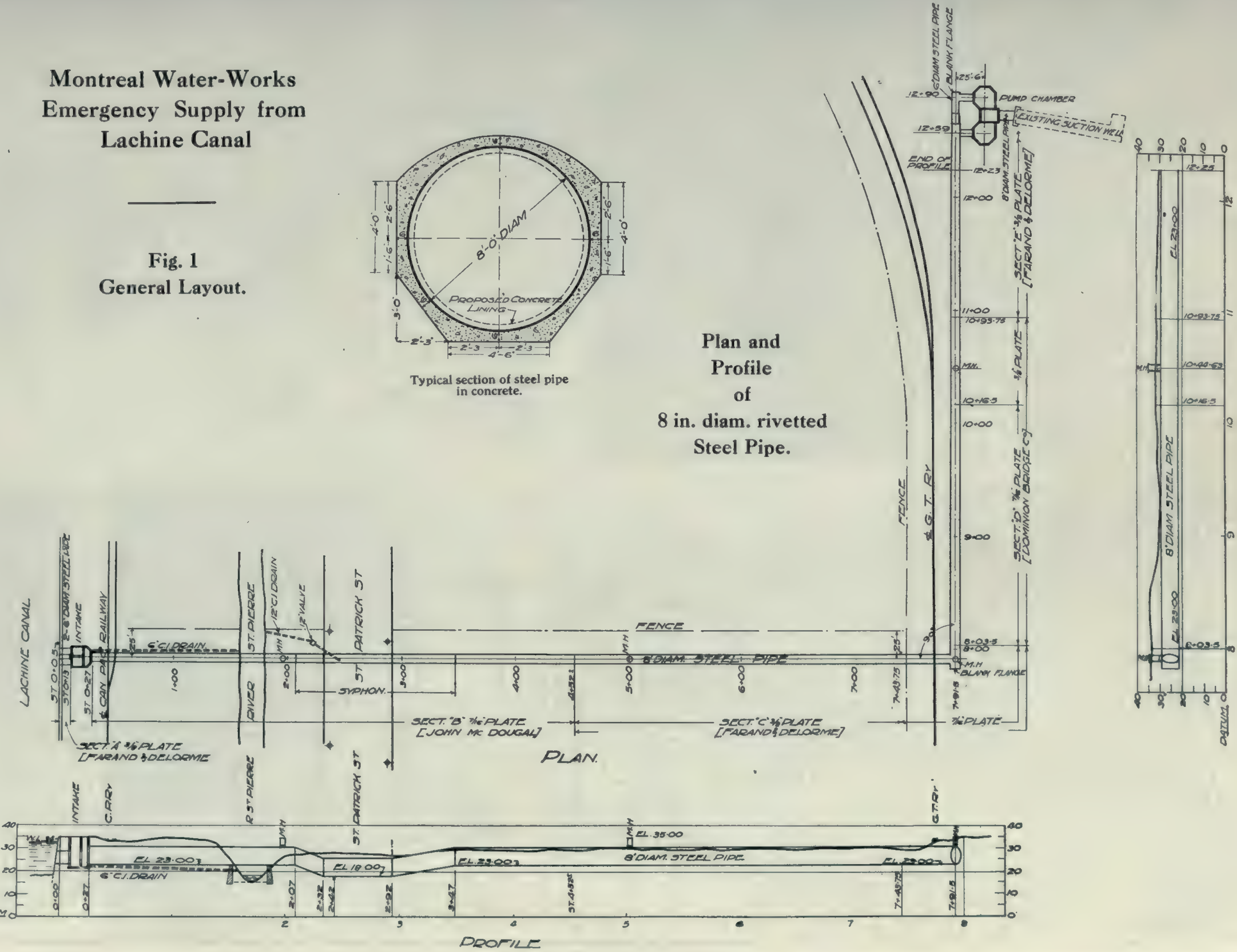
Intake.—The details of the intake are shown in Fig. 2 and the connections with the Lachine Canal in Fig. 3. Two 6-ft. pipes enter the intake from the canal, each being controlled by a 72 x 60 in. sluice gate. These sluice gates are of the non-rising stem type and are operated by removable capstan heads at the floor level. This type was required so as to have no structure above the level of the canal bank obstruct the tow-path or interfere with the loading or unloading of barges. Screens, not shown, are provided to slide in the stop plank grooves in front of each sluice gate.

A temporary crib was constructed in the canal about the entrance to the intake, as it was expected that the connection between the intake and the canal would have to be made without unwatering the latter. The canal was drained earlier than usual, however, to permit of necessary repairs and new work; consequently it was possible to complete the intake work under very favorable conditions.

Bridge.—Details of the crossing over the River St. Pierre are shown in Fig. 2. In Fig. 4 this crossing is shown after completion. It is an illustration of how an otherwise ugly structure, built solely for utility,

Montreal Water-Works Emergency Supply from Lachine Canal

Fig. 1
General Layout.



Typical section of steel pipe in concrete.

Plan and Profile of 8 in. diam. rivetted Steel Pipe.

may be made quite attractive by a small amount of inexpensive detail work.

Pipe Line.—The normal water level in the canal is less than one foot higher than that at present required in the existing suction well at the low level pumping station. It was therefore decided to use a pipe with an internal diameter of 8 feet, to minimize friction loss and permit of a gravity supply under ordinary conditions.

Eight-foot rivetted steel pipe was contracted for, as this could be obtained and laid more advantageously under the extremely severe weather conditions at the time the work was to be done. Figs. 5 and 6 show the pipe-line work during construction.

To preserve the pipe from destruction, it has been surrounded by six inches of concrete. The interior surface will be either painted or lined with cement mortar.

When not in service the pipe is to be kept empty by means of a 12-in. drain from the syphon under St. Patrick Street to the River St. Pierre.

Pump Wells.—The pump wells are two in number, each octagonal in plan, 18 feet in diameter and 22 feet deep, with 18-inch reinforced concrete walls. The two pump wells are separated by a central well which forms a continuation of the existing suction well. The 8-foot rivetted steel supply pipe branches off into two 6-foot pipes, one entering each pump well.

The flow of water from each pump well to the central and suction well is controlled by one 72 x 60 in. sluice gate and one 36-in. gate valve. Under ordinary conditions both of these are closed and the pump wells and 8-foot pipe-line are empty.

If the emergency supply is required, the sluice gates are opened both at the intake and in the pump wells, thus permitting water from the Lachine Canal to flow into the suction well. In case the water level in the canal is too low for a gravity supply, the 72 x 60 in. sluice gates in the pump wells are closed, the pumps started and the 36-in. gate valves opened, thus allowing the discharge from the pumps to enter the central well and pass on into the existing suction well.

Pumping Equipment.—In each pump well there is being installed a centrifugal pump of the submerged type with vertical shaft, having a capacity of forty million Imperial gallons of water in twenty-four hours against a lift of 5 feet. Each pump is belt driven by a 75 h.p. motor, working under 2,200 volts, alternating current.

Superstructure.—A red brick building with green

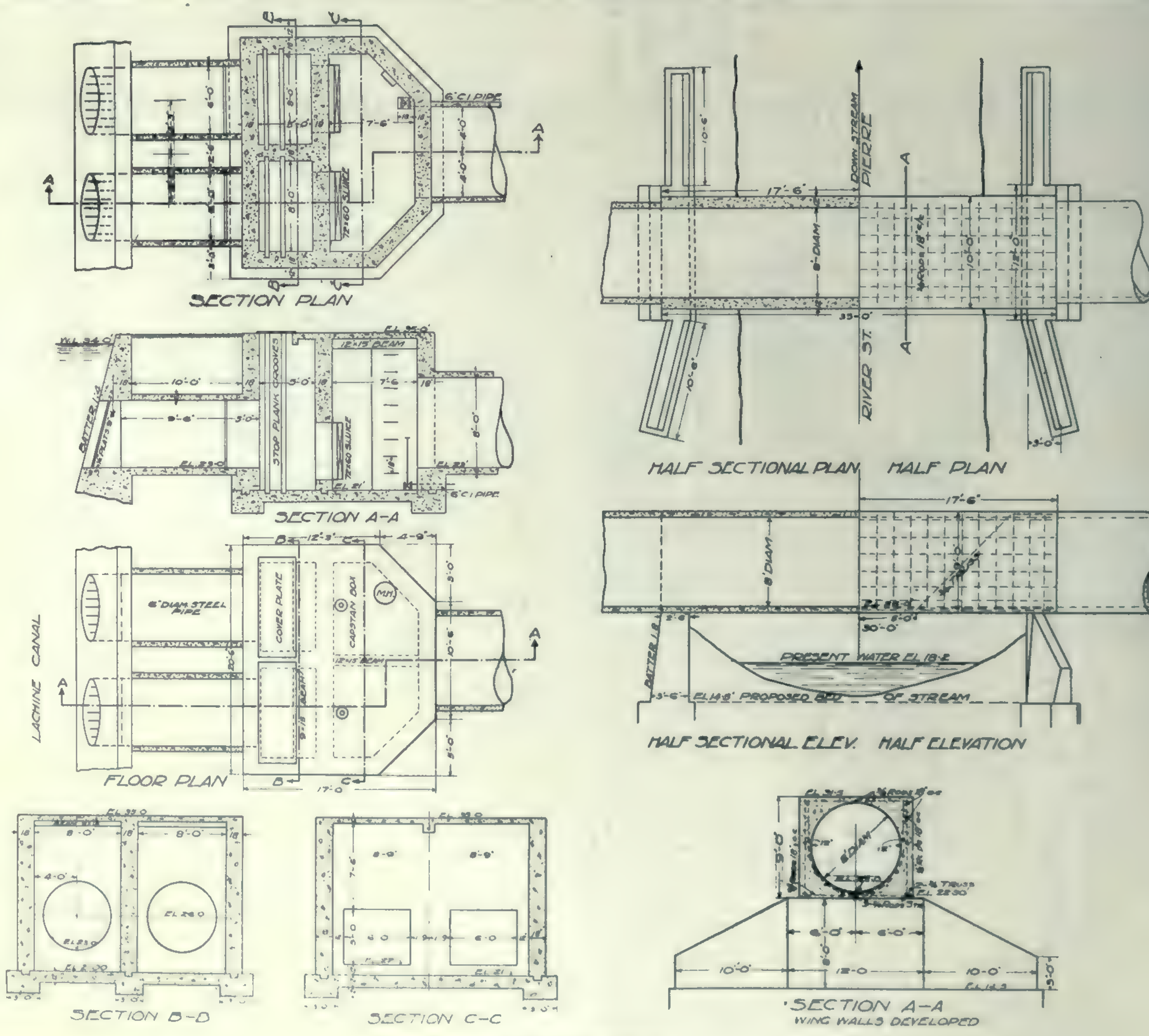


Fig. 2—Details of Intake.

tile roof, laid on cinder concrete, will be built over the pump wells.

CONSTRUCTION METHODS

The methods of carrying on the work were influenced greatly by the severity of the weather conditions. Fig. 7 shows the maximum, minimum and mean daily temperatures as abstracted from the records of McGill College Observatory.

In January, 1914, the temperature fell below zero on twelve days and below 20 deg. on all but five days. The coldest day was on January 13, when the maximum temperature was minus 15 deg. and the minimum temperature was minus 27.1 deg. During this month 31.2 inches of snow and 1.11 inches of rain fell.

In February, 1914, the temperature fell below zero on eighteen days and below 20 deg. on all but two days. The coldest day was on February 11th, when the maximum temperature was minus 12.3 and the minimum temperature minus 26.9. The maximum temperature for the three days, February 11, 12 and 13, was minus 4.2 deg. During this month 14.9 inches of snow and .08 inches of rain fell.

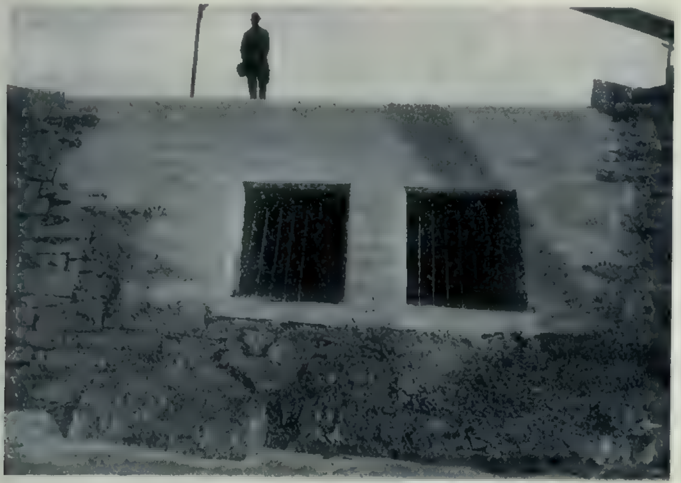


Fig. 3—Intake from Lachine Canal.

The averages of the daily temperatures for the three months are as follows:

	Mean	Maximum	Minimum
January, 1914* ...	12.29	20.1	4.3
February, 1914* .	7.41	15.1	minus 0.7
March, 1914* .. .	27.46	33.07	21.60

*Average of the mean of bi-hourly readings from self-recording instruments.

Organization.—As the work was to be carried on with all possible speed, the laborers were first divided into three shifts, each shift working continuously for eight hours without stopping for lunch; later, as the work approached completion, only two shifts were employed, and finally, after all piping and concrete work were finished, also backfilling, minor details, and cleaning up grounds, day shift alone was kept on.

Plant.—Three concrete mixers were installed. One was located at the pump wells and one half way between St. Patrick Street and the Grand Trunk Railroad, while the third handled the work between St. Patrick Street and the Canal.

Two stiff-leg derricks were used. One was placed near the pump wells and the other at the intake. These handled earth work, forms, piping and concrete.

An air compressor was located about midway along the line of pipe to supply air to the rivetting machines.

Two material sheds were erected, one near St. Patrick Street and the other at the pump wells. These were provided with steam heating coils (at the floor level) over which the stone and sand used for concrete were piled in order that this material might be dry and hot when transported to the concrete mixers. Steam, water and air piping were laid continuously along the entire length of the pipe line.

The 8-foot rivetted steel pipe was handled by means of three-pole derricks, spanning the pipe trench.

Pipe Laying.—As soon as the pipe trench was excavated, the sections of steel pipe were lowered into the trench and rivetted together in lengths varying from 15 to 24 feet. Coke-burning salamanders were then placed inside of the pipe, and the trench was thoroughly thawed out by means of steam lines. Tarpaulins were spread over the pipe and pipe trench to retain the heat and prevent freezing during the work of concreting about the pipe. This concreting was carried on as rapidly as conditions would permit. The weather was so cold that it was found necessary to house the concrete mixers, which were driven by gasoline engines.

The cement and the heated sand and broken stone were brought from the material sheds to the mixers by wheelbarrows. The material was mixed with hot water and then conveyed to the work by wheelbarrows. As soon as the pipe was concreted it was covered with tarpaulins, under which steam pipes were laid to prevent any freezing of the concrete.

Intake and Pump Wells.—The concreting of these was done in like manner, special care being taken to enclose the work with tarpaulins, provide sufficient heating coils to prevent freezing, and work as much as possible under cover.

The protective measures taken were entirely adequate and none of the concrete was found to be frostbitten, notwithstanding the extremely low temperatures.

Connection with existing Suction Well.—The making of the connection between the pump wells and the existing suction well was not the least interesting part of the work. The existing suction well is a reinforced concrete structure about 85 feet long, 10 feet wide and 24 feet deep, with a concrete arched roof. Through this suction well flows the entire water supply of the low level pumping station to a depth varying from 12 to 16 feet. As this suction well could not be drained without shutting off the city's water supply, the con-

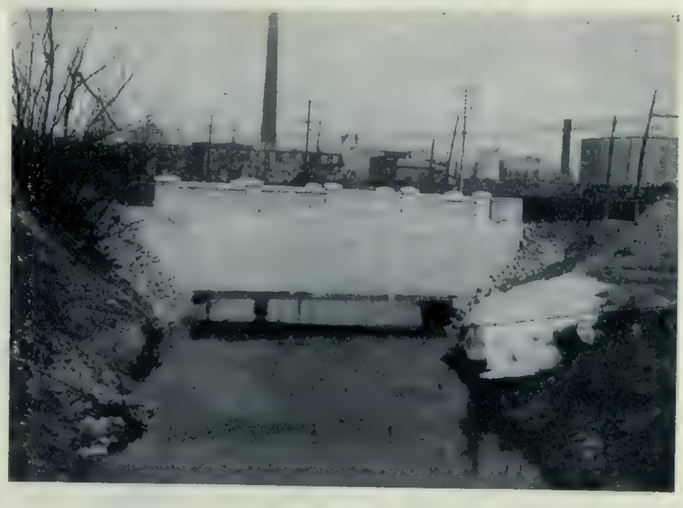


Fig. 4—Pipe crossing River St. Pierre.

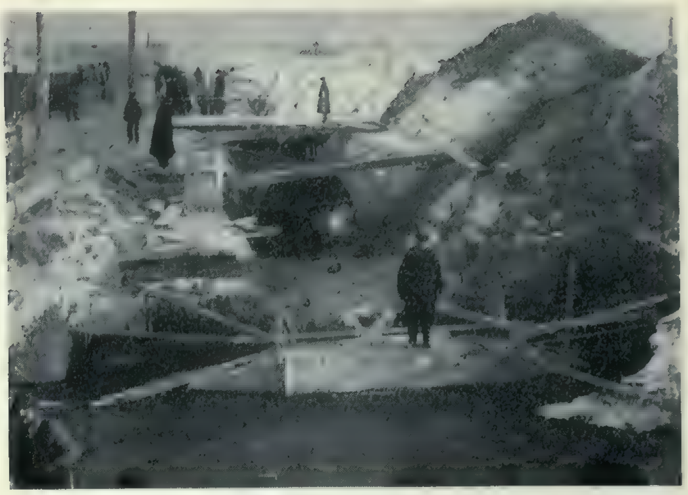


Fig. 5–Pipe line near River St. Pierre.

nection had to be made with the suction well in service.

A diver was employed to place a timber bulkhead across the end of the suction well, leaving sufficient space between the bulkhead and the end of the chamber to permit of the end wall being cut through. This bulkhead was made up of 12 x 12 in. timbers weighted down by pig lead. Between each two timbers were placed two parallel pieces of 1-inch rubber hose, running the entire length of the timbers. When the bulkhead was completed above the water level, jacks were used to force the timbers down one upon the other and the pieces of hose were sufficiently compressed to act as gaskets and make the bulkhead practically water-tight.

The section of 8-foot pipe between the pump wells and suction well was then laid and surrounded by concrete. After this concrete was placed, an 8-foot circular opening was cut through the 20-inch reinforced end wall of the suction well by means of air drills. After this was done the pipe and central well were filled with water to balance the pressure on both sides of the bulkhead and the bulkhead was removed by the diver, thus completing the pipe-line from the Lachine Canal to the existing suction well.

Progress

Rapid progress was, of course, difficult on account of the extreme cold; moreover, the final completion was delayed from ten to fifteen days on account of failure to obtain the necessary official permission to cross the railroads' right-of-way. This interfered particularly with rapid progress on the pipe-laying.

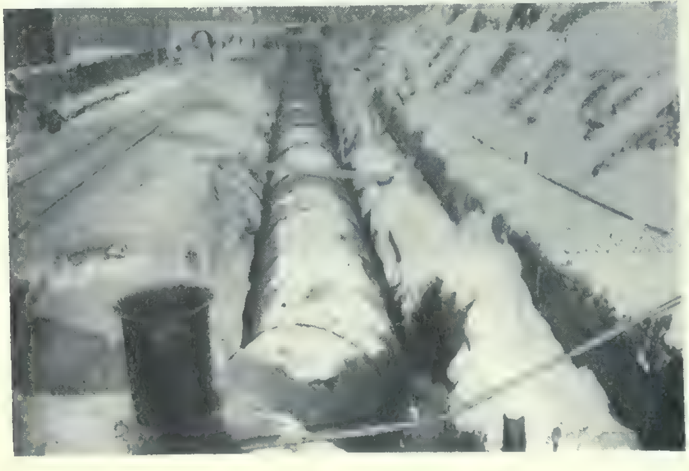


Fig. 6–Pipe line along Grand Trunk Railroad.

Taking all conditions into consideration the rate of progress was very satisfactory. This may be stated briefly as follows:

January 2, 1914.—Emergency Supply System from Lachine Canal decided upon.

January 8, 1914.—Orders given for first 800 feet of 8-foot rivetted steel pipe.

January 12, 1914.—Contractor started excavation of pipe trench.

January 15, 1914.—First sections of 8-foot rivetted steel pipe delivered.

January 25, 1914.—First sections of 8-foot pipe placed in trench.

January 29, 1914.—G. T. R. and C. P. R. driving piles for temporary stringers at pipe crossings.

February 3, 1914.—Contract awarded for two 40-million gallon pumps. Concreting about pipe started.

February 4, 1914.—About 600 feet of 8-foot pipe laid and rivetted.

February 20, 1914.—Pipe laid entire distance from intake to pump wells.

February 22, 1914.—Floor of pump wells completed.

March 6, 1914.—Concrete in pump wells completed.

March 12, 1914.—Intake concreted.

March 14, 1914.—All concreting about pipe from intake to pump wells completed.

March 22, 1914.—Section of 8-foot steel pipe laid between pump wells and suction well.

March 30, 1914.—Started to cut through into suction well.

March 31, 1914.—Erection of both 40-million gallon pumps started.

April 3, 1914.—Connection into suction well completed.

April 7, 1914.—Bulkhead removed from suction well and gravity system ready for service if required.

COST OF THE WORK

The cost of the work was naturally greater than would be expected under more favorable weather conditions. A close approximation may be summarized as follows:—

Rivetted steel pipe, furnished and delivered..	$ 32,300
Sluice gates, valves and c.i. piping	5,860
Two 40-million Imperial gallon centrifugal pumps with switchboard, motors and appurtenances	6,530
Structural steel for roof trusses and pumps.	500
Pay-rolls, covering earthwork, pipe-laying, concrete and miscellaneous work, on basis of cost plus 10 per cent.	74,565
Materials of construction, including cement, sand, stone, lumber, repairs to plant, etc., on basis of cost plus 10 per cent.	38,270
Rental of plant	2,400
Insurance of laborers	2,400
Superstructure of pumping station (estimated)	4,000
Miscellaneous (estimated)	675
Engineering and inspection (estimated)	2,500
Total	$170,000

Based on a minimum capacity of 80 million Imperial gallons a day, the cost of the construction of the Emergency Supply System is therefore approximately $2,100 per million gallons daily capacity.

WORK AND MATERIALS

The more important parts of the work were done by the following firms: Rivetted steel pipe.—Messrs. Farand & Delorme, the Dominion Bridge Company, and Messrs. John McDougall Caledonian Iron Works Company. Sluice gates.—Messrs. Coldwell Wilcox Company. Pumps and appurtenances.—Messrs. John McDougall Caledonian Iron Works Company. Construction work, including earthwork, pipe-laying and concrete work.—Messrs. Laurin, Leitch & Company.

LACHINE CANAL WATER FOR DOMESTIC USE

The water in the Lachine Canal is composed of the waters of the St. Lawrence and Ottawa Rivers, in varying proportions, due to climatic changes. Experiments covering a period of two years have shown that this canal water may be made safe for domestic use by proper chemical treatment. Provisions have therefore been made for the sterilization of this water supply when in use by treatment with a solution of hypochlorite of lime, which will be mixed with the canal water just prior to its entrance to the pump wells.

The public is therefore assured not only of an ample supply of water for emergency fire needs, but also that this water before its delivery into the supply mains will be so treated as to make it perfectly safe for domestic consumption.

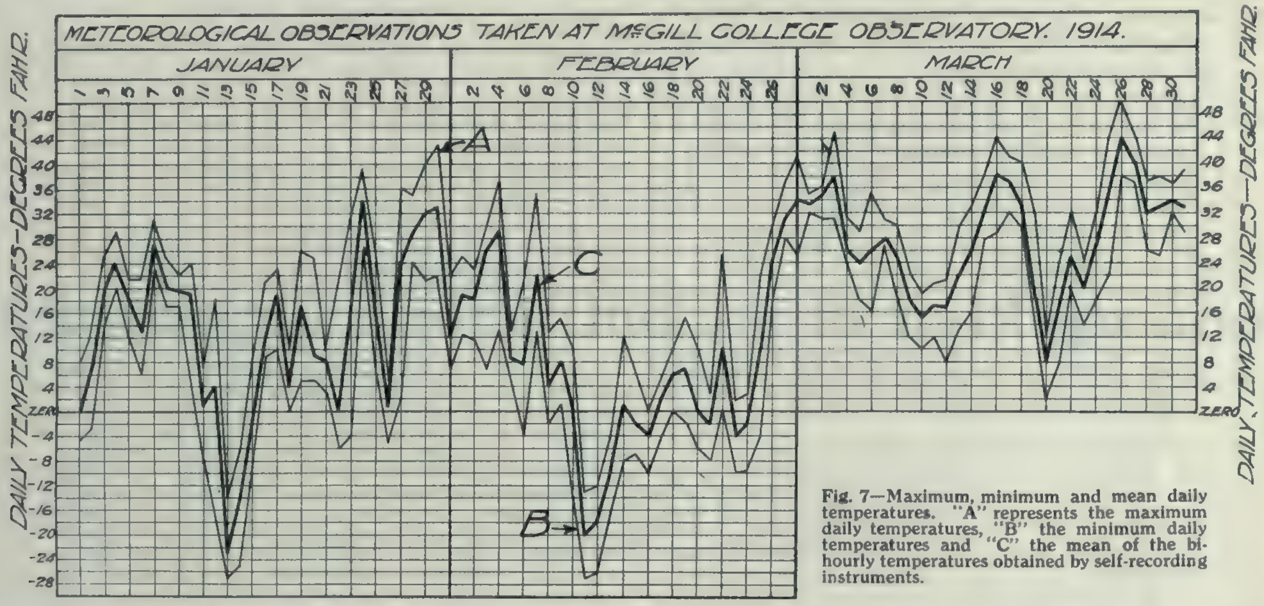


Fig. 7—Maximum, minimum and mean daily temperatures. "A" represents the maximum daily temperatures, "B" the minimum daily temperatures and "C" the mean of the bi-hourly temperatures obtained by self-recording instruments.

Hydrated Lime in Concrete Road Surfaces

By Robert S. Edwards

THE general conditions under which concrete pavements are placed are severe, as the majority of work is usually done in the dry spring and summer months when temperatures are high, causing excessive evaporation. The concrete is generally poured on an earth or clay sub-base in a thin slab varying between 4 ins. and 7 ins. in thickness. This condition alone makes it almost impossible to secure uniformity throughout the concrete mass, so that after hardening the concrete road slab is subject to far greater variation, due to the segregation of the coarse aggregate from the mortar, than is found in other forms of concrete work. This, of necessity, causes unevenness throughout the concrete, and the excessive cracking and unravelling so often seen in poorly laid concrete roads is directly due to this fact.

It is the writer's opinion that the primary cause of cracking in concrete pavements is due to the loss or leakage of varying portions of the mixing water from the concrete by seepage through the sub-base, as well as by evaporation from the surface of the concrete, which leaves the concrete road slab in such a condition that at later times it will alternately absorb and give up water, depending on the season of the year, and that expansion and contraction of concrete and any movement in its volume are due infinitely more to this alternate wet and dry condition than to any temperature change from hot to cold without presence of moisture.

That the cracking which is directly attributed to the change in the condition of the sub-base, either in settlement spots or in drying out in shrinking, is primarily due to this cause, which is greatly helped by unevenness and variability of the concrete mixture.

That there are extremely few, if any, concrete pavements. individual slabs of which can be considered entirely uniform.

The Use of Hydrated Lime.—Hydrated lime is a product formed by the addition of accurate quantities of water to known weights of freshly burned quicklime, the finished material being a flour-like powder of great fineness and covering capacity, having more than twice the volume of the same weight of cement in its dry state.

The use of hydrated lime as a void filler in concrete mixtures, and for rendering concrete mixtures more water-tight, dates back several years. Numerous tests show that a replacement of from 10 to 15 per cent of cement by hydrated lime in rich concrete mixtures does not decrease the compressive strength of the concrete after three to four months' time, and ultimately increases the strength and permanence of the concrete. It apparently makes but little difference as to its action as a void filler, whether the hydrate is manufactured from a dolomitic or high magnesia lime or a high calcium lime—it being necessary only to have a product which contains no free lime or unslacked particles. The proper hydration or dry slacking of lime reduces it to a finer degree of sub-division than can be accomplished by any mechanical means.

The amount of water required to convert the dry hydrated lime into a plastic paste varies from 50 to 70 per cent of the weight of the lime; while, to obtain a mortar of similar consistency with Portland cement, an addition of 25 to 30 per cent of water is required.

Unlike Portland cement, however, the addition of water to hydrated lime does not create any chemical reactions. There is simply a lime paste formed which holds its excess water for a long time. Upon the addition of small quantities of hydrated lime, amounting to 10 or 15 per cent, to the weight of cement used in concrete mixtures and the ordinary mixing of such mixtures, the hydrate, which has absorbed a large amount of water, corresponding to its weight, is thoroughly disseminated throughout the concrete mass, and, due to its fine plastic conditions, it is forced immediately into places in the concrete which the cement cannot reach.

Concrete, so mixed, on leaving the mixer, flows more readily into place and the coarse aggregate has much less tendency towards segregation in the concrete mass. In other words, the extremely finely divided condition of the moistened hydrated lime paste has increased, to a marked degree, the covering or spreading quality of the cement, and reduced, to a similarly marked degree, the friction between particles of fine and coarse aggregate.

This answers the question "Why does hydrated lime benefit concrete?" The action is purely a mechanical one, and can be compared to the oiling or greasing of a shaft or bearing. The property which hydrated lime has of absorbing and retaining large percentages of water offers a ready solution to the problem of finding a means for keeping and holding moisture in freshly poured concrete pavements until the slower-acting cement-hardening process can utilize it.

It is obvious that small percentages of hydrated lime, when added to concrete mixtures, in road work, will accomplish the following things:

1. Renders the concrete highly plastic and homogeneous, thus producing density and uniformity in the finished concrete. This condition adds much to the life and efficiency of the road because of the uniform resistance to wear and other stresses.
2. Keeps a certain amount of excess moisture in the concrete while setting.
3. Renders the concrete mass more nearly watertight, thereby preventing the alternate wetting and drying out of the finished concrete.
4. In large pieces of work, these properties given to concrete by hydrated lime would materially reduce the labor in spreading and bringing the concrete to a uniform surface which is of great importance in paving work.

*Extract from paper before the National Lime Manufacturers' Association.

Training Men in a Contractor's Organization

TRAINED men in any line of endeavor are a necessity—and likewise a scarcity—and as contracting is both a business and a profession the need of such men is emphasized. Anyone just starting into contracting has the need of trained men brought forcibly to him, while large construction companies always are on the lookout for men of this kind.

Men, to be of value, must be not only trained but ambitious and competent. Such men need only be known to be in demand, and can command large wages; for in the end these men are the cheapest. Their mistakes are few and inexpensive; and besides, from their training they are enabled to devise many new labor-saving methods. It is the cheap, inexperienced man that is expensive.

There is a need to-day for teaching engineering contracting in our colleges; for if contracting is a science, as is claimed by some, then it can be taught, and there is a growing demand among young engineering students to take up this branch of engineering.

However, a course in college and a degree will not make a contractor, any more than it will an engineer; but as in the case of an engineer, it gives a good technical foundation upon which to build, and supplies the means to fit a man quicker for his life work, as it allows the young man to profit from the experience of others, assimilating from others the results that would take years to obtain in his own career. The case is analagous to that of a man who spends months to calculate that he could secure in some handbook for a few dollars.

But whether a man has a college training or not, he must still go through the practical training in order to become proficient. Even if he never becomes an expert, at least he must be so well trained that his work will be efficient, and he can be relied upon by those who employ him.

This subject of training men is being given much thought and attraction in the twentieth century. Many of the large commercial organizations have come to realize the value of trained men—not only trained to their particular line of business or profession, but also to their own particular methods and systems; and they are therefore devising apprenticeships and training courses so as to no longer be dependent upon chance to pick up efficient men.

The railroad companies are also beginning to realize that it is necessary to train men, instead of waiting many years for men to get the experience that will fit them for operating officials. Within the past decade one of the ablest railroad financiers and organizers came to the conclusion that it was the wrong principle to wait until a man became 45 or 50 years of age before he was competent to be made a superintendent, for he may then have only from 10 to 20 years of usefulness before him. So this man began to experiment with picked young men, to try to train them for such positions in from three to five years, so that they might become operating officials, and possibly more efficient ones, before they are 30 years of age, when they have before them a career of from 30 to 40 years. Not every man selected stands the training, nor do all who go through the course measure up to the standard; but the venture may be termed successful and the results obtained have justified the methods to such an extent that other roads are copying them.

One mistake sometimes made by organizations that are now training men is to take it for granted that a large per cent of the young men selected will not make good; and going on this principle but little help is extended, so that many actually do fail. Thus money must be expended to train or partially train a much larger number than is needed. It may not be wrong to tell the young man starting that the majority fail, as this may act as a spur to him and put him on his mettle to make good; but it is absolutely essential that these young men be not only trained but assisted and guided and a watchful eye kept on them. Man has never devised a machine that did not need some attention in order to keep it running; and so it is with the human machine—if success is to be obtained, watchfulness and attention must be the price paid.

As it is possible to train men in commercial lines and in railroad operation, so it can be done in the contracting field, and men can be made efficient managers within a comparatively short time.

First, there must be a standard set for the selection of the men to be trained. Such a standard need not necessarily be high as to education, although the broader a man's education, the more likelihood of his being successful. However, the standard should be high as to the applicant's character and natural ability. As a rule the man should be unmarried, of good health and habits and of a bouyant disposition. But hard and fast rules for selecting must be deviated from at times; for the exceptional man will appear, who if accepted may prove quick at learning and be ready to take up difficult tasks many years before others can be trusted to undertake them.

The contractor doing a limited amount of work can train men just as well as those operating on a large scale; in fact, better, for the young men will come directly under his care, and not be trained by a subordinate who may have little interest in the proposed scheme. He, too, is as much in need of trained men as his larger competitor, especially if he hopes to expand his business.

It is useless to train men and then not treat them so as to retain them in the organization. The course that they are put through will make them valuable in a much shorter time than if they "just growed" as Topsy did; hence if they can earn money much more quickly for their employer, they themselves must be paid salaries commensurate with their earning power. Many contractors seem to overlook this fact, gauging the salaries they pay, not so much by the earning power of the employee but rather by the salaries others pay men of about the same age and years of experience. Thus as men are trained and become valuable they leave to go with other contractors who are willing to pay according to the value received from their men.

One firm of contractors that has advanced by rapid strides within the last 10 or 15 years owes much of its success to the fact that the head of the firm has the ability to select good men as managers, and he pays such salaries as to attract them, and as they come to know his ways and methods, and prove their value to him, he keeps their salaries at a high standard, until to-day he has a larger staff of high salaried men and is paying higher wages than almost any contractor in the country. This really accounts for his success. By keeping his men satisfied he has held the same staff for years. The earnings of such men more than offset their salaries.

The selection of a course of training will vary somewhat with each contracting organization, just as the courses for the same degree vary in our leading colleges, but the general studies and methods can be the same.

First of all, the man to be trained must have some knowledge of mathematics. The more training and the greater the knowledge he has received in this line, the easier will be his other work; for applied mathematics is the foundation of all professions except those of belles lettres. Arithmetic, proportion and algebra are absolutely essential, while geometry and trigonometry will be found a great advantage in solving many problems. Elementary mechanics should likewise be studied, and the general principles of electricity. If the applicant has not had this course of training he should be sent to a night school, put under a private tutor, or given a course in a reliable correspondence school.

If anyone should ask the writer upon what side of contracting most contractors are weakest, he would not hesitate in saying the clerical or office end. Therefore, he would start the young man in that part of the work. The accounting should be the first thing to tackle. He should not only be taught the methods, but the reasons should be shown for using these methods. The routine work is the small part; he must obtain a clear understanding of the entire system. From this he should be given the test of making up special reports, to show the application of all clerical work. The gathering of such statistics will give him a comprehensive knowledge of the entire subject of contracting. This once obtained, he will be able to take in the details much better, and this recording and rehandling of the details will then be the next step.

The writer knows that many will differ with him as to this; but from experience and a close study of successes and failures in contracting, the writer does not hesitate in asserting that those trained in the general principles first and then made to cover the details, get a broader and more comprehensive training and their rise is more rapid. It must be remembered that the training of clerks and bookkeepers is not being considered—these start with the simple details and work up; but rather the men who are to handle important contracts, the future general managers and partners.

The next task should be the time keeping, the making up of payrolls, the handling of the workmen's individual accounts, and the actual paying off of the men. This will bring the beginner into first close touch with the vast army of industrial workers. He will get to know these men from their worst side—the grasping of money, whether it has been earned or not; he will learn the petty deceits, and the frauds practiced by foremen to obtain money for themselves, both from the contractor and his employees. He will be impressed with the importance of having these things correct and of keeping the men satisfied. In all of this work supervision must be given the man, but he must be placed on his own resources and made to rely on himself. He should be taught not to worry his superiors with useless questions, but to find out things for himself; but it will be well to explain to him the underlying principles of everything he is given to do.

At this stage he should be shown the importance of supplementing his work with reading. He should follow articles in the contracting and engineering journals, the proceedings of societies, and read books covering contracting and engineering in a general way. This reading should be kept up the rest of his life; and later when he gets to handling construction work, he should read books on the various classes of work being done, as concrete, excavation, sewers, railroads and other construction. These books should be referred to from time to time.

After time keeping, he should handle cost keeping, and the collection of all cost data. Then he should be taught the analyzing of costs and the use of cost data. This will give him an insight into estimating and the methods of doing work and the building up of a contract system and organization. He will learn of the various classes of work, their units, the sequence of events in carrying on construction, and many other details that will prove of value in the next steps of his training.

From cost keeping he will go to the first work that will bring him into intimate touch with actual construction, that is, the handling of supplies and materials. He will receive and check materials and supplies. In doing this, more so than in cost keeping, he will learn prices and see the need of closer buying. He will learn of wastes and how to prevent them. He will, if he keeps the proper records, get to know how much of each kind of supplies are needed weekly or machines and different classes of work. He will begin to learn of the care and repair of machines and tools.

In handling materials he will learn that the work of men is dependent upon receiving regular supplies of the materials, of the proper storage from the weather and to prevent them being rehandled uselessly. He will be brought face to face with executive problems, and not only how they must be solved but how to devise expedients to overcome unexpected delays and difficulties. He will now be an important part of the organization, the success of the entire job depending upon him. In receiving and handling the supplies and materials he will have his first experience in handling the men and teams that must work under his direction. This will be valuable experience for him, for he will get to know men, and as his forces will be scattered and difficult to watch he will need to use his head to keep them busy and know they are following instructions. This might be termed his preliminary training and it will cover a period of from one to two years.

The next step begins the real training for construction work. A small ditch has to be excavated to let off some rain water, or some similar job needs to be done, and the young man is given a small crew of men and set to work as foreman. This done, he is sent with his crew to assist some foreman, and he becomes a sub-foreman. Here he learns to obey, for no man is fitted to command others until he has learned obedience himself.

From sub-foreman he is sent with an extra gang to do odd jobs, his men being changed frequently so he will learn that different individuals must be handled in a variety of ways. From extra gang, he is given the foremanship of a gang doing some hard, monotonous work, where he will experience the daily routine grind of doing some difficult task, that will ordinarily take the heart out of the average man.

Then as occasion arises he can be given a job where he may have to handle several forces and rely much on his own judgment. Thus by changing from job to job and from one class of work to another he will gain experience under different general managers and on various kinds of work under many different conditions.

On some new job he can be sent out as assistant to the man who is to run the work. Here he can help to plan the job, organize the forces, assist in buying machines, materials and supplies and learn much that will benefit him. From this he could be given some small piece of construction to start and superintend himself, where he will have to keep his time and cost keeping, do his bookkeeping and buying, run his gangs, and in fact be everything that a small contractor must be, in order to make both ends meet. Here will be his supreme test; and if he makes good he will go on with his work, working mostly under others, unless he shows exceptional ability, until he learns how to estimate, plan out jobs and start them, and finally take charge of large undertakings.

Many young men selected will fall by the wayside. Some will have to be dropped soon, others will never get beyond the office work, making only good clerks; others will master these and some of the outside details, while a few will go through the entire course, making first-class trained men and amply repaying for the time and money spent on all of them.

The Results of Hypo-chlorite Treatment of Water

In a paper read before the Illinois Water Supply Association by Mr. C. A. Jennings, it is shown that 600 cities in the United States are using hypochlorite for water sterilization. It is further shown that no city following a proper procedure has found it necessary to discontinue its use. Where poorly designed plant and improper working have led to trouble the method has, however, fallen into undeserved disrepute. It has sometimes been assumed that the application of hypochlorite would remedy a condition quite outside the sphere of its usefulness.

Statistics were quoted in this paper showing the results obtained at eight American cities where hypochlorite sterilization has been adopted. Of the eight cities the maximum reduction in the typhoid death-rate was 72 per cent at Cleveland and the minimum 35 per cent in Baltimore. The average reduction was 51 per cent. The total population considered was 2,033,000, with a reduction per 100,000 population for each year of 15.8 deaths.

At Baltimore, hypochlorite treatment of the water was started in June, 1911. Here the death-rate from typhoid fever was 35.2 per 100,000; during the period from 1900 to 1910 this death-rate fell to 22.8 per 100,000 in 1912-1913 after using hypochlorite. At Cleveland, where the treatment started in September, 1911, the death-rate fell from 35.5 during the preceding ten years to 10.0. At DesMoines the treatment was started in December, 1910. Here the death-rate fell from 22.7 during the preceding five years to 13.4. At Erie the treatment was started in March, 1911. The death-rate in this case fell from 38.7 in the preceding ten years to 13.5. At Evanston, where the treatment was started in December, 1911, the death-rate fell from 26.0 during the preceding three years to 14.5. In Jersey City the treatment was started in September, 1908, and the death-rate, which was 18.7 during the preceding seven years, fell to 9.3. At Kansas City the treatment was started in January, 1911, and the death-rate fell from 42.5 during the preceding ten years to 20.0. At Omaha the treatment was started in May, 1910, and the death-rate, which was 22.5 from 1900 to 1909, fell to 11.8. Such are the beneficial results of water sterilization in America.

The supply main leading from the terminus of the Weston aqueduct of the metropolitan water district, Boston, toward Chestnut Hill reservoir, which was laid in 1902 and 1903, has been cleaned for a distance of 6,800 ft. at a cost of $384.25, or $0.056 per foot. The tubercles were removed from the interior of the pipe by laborers using wood and iron scrapers, and the pipe was then washed by the use of a spraying machine, using a jet from a ¼-in. diameter nozzle under a pressure of 200 lbs. per square inch. The lighter material was washed out of the blowoffs, and 45 cu. ft. of the heavier material, composed principally of tubercles, were removed in pails. The work is described by Dexter Brackett, chief engineer of the Metropolitan Water Board, in his annual report for 1913.

Making Railroad Fill from Pontoon Bridge

Half way between Winnipeg and Port Arthur it was found desirable to locate the main line of the Canadian Northern Railway across an arm of Rainy Lake. It was decided to make a rockfill for the crossing, which was 3 miles long, and in order to avoid the necessity of driving piles to support the work trains a special pontoon arrangement was devised.

Surveys for determining the nature of the permanent construction were started in 1908, and it was found that the depth to rock bottom was so great that the piers for a series of steel bridges would be very costly. The mud overlying the rock was too soft to hold clusters of piling, but was also pronounced too stiff to allow rock-filled cribs to sink to foundation.

Study of Lake Bottom

Study of the lake bottom was carried on through the ice for two winters, and was then finished on open water by what is said to have been a more satisfactory method. The summer soundings were made from a 22 x 34-ft. barge with a driving machine over a central well opening. A 70-lb. hammer was used to sink extra-heavy 1¼-in. strain pipe to refusal. This pipe was joined together in 10-ft. sections by threaded couplings, and steel specials for point and cap were provided. As many as twenty-eight soundings in a day were taken with this equipment.

With this detailed information about the lake bottom at hand, it was decided to make a solid rockfill for the entire crossing. When the most economical projection of the line across the water had been determined, it was found that the fill would have to be more than 60 ft. deep in some places and that a total of about 1,000,000 cu. yd. of rock would be required. Quarries were located on company property near the lake shores, so that an average haul of only 1 mile was necessary. The line was located so as to take advantage of five rocky islands along the route, and of course rock from these was used in starting fills out from their shores. In October, 1910, two model C 95-ton Bucyrus steam shovels were put to work loading broken rock into 12-yd. standard-gage dump cars, and two more were added a few months later. All four shovels were in commission until the fall of 1912, and during this time each sometimes handled as much as 50,000 cu. yd. of rock per month.

Floating Track Over Dump

One of the difficulties encountered at the outset was the necessity for some method of dumping the rock so that it would give no trouble in settling into the desired position. A very satisfactory solution of this problem was devised in the shape of a dumper consisting of two 6-ft. plate girders 30 ft. apart, with floorbeams 30 ft. apart on the end at which dumping was done, and shorter distances apart for the remainder of the truss. The track was supported on stringers at the centre, leaving distances of 11 ft. between girders and the ends of the ties through which the material was dumped. Originally the girders were 120 ft. long, but they were afterward lengthened to 140 ft. so as to carry six 12-yd. cars at one time.

The support for the truss, 75 ft. from the embankment end, was a 32 x 112-ft. barge capable of carrying 200,000 lbs. for each foot of displacement. When not resting on the head of the bank, the shore end was supported by two pontoons placed about 40 ft. apart. A girder with a portal entrance and bracing carried the weight from the shore end of the dumper to these pontoons. The truss was supported on the main barge by cribbing so that it could be raised or lowered according to the height of the finished embankment above water. For the most of the work this was about 15 ft. above the lake surface.

At each end of the barge were capstans from which lines ran out nearly perpendicular for nearly 1,000 ft. to the shores of small islands or to a 5-ton anchor block of stone. A forward line was carried from a winch on the barge and used for warping the barge in moving forward.

Two heavy saw logs were attached to the shore end of the barge, with the small ends toward the shore, so that they formed a support for the track until the head of the bank was brought entirely up to grade, usually a distance of not more than 2 ft.

Dumping could generally proceed until the top was within 2 ft. of grade before it was necessary to move ahead. When the dumper was first built it was anticipated that about 1 hour would be required to move the device, but in actual practice only 3 or 4 minutes were needed, and dumping could proceed as soon as the track was laid over the space left vacant on the head of the bank. Usually the whole operation consumed about 15 minutes.

When the fill had been brought up sufficiently near the surface the floating bridge was moved ahead and the widening and finishing up of the grade was left to be done by side dumping. About one-third of the grade was usually added in this way after the floating bridge had moved on.

In closing up the work the gap finally became too short to permit the use of the barges supporting the dumping track. The embankment was then gradually advanced from the east until the gap was short enough so that the 140-ft. steel girders could be floated in on the main barge and bearings secured for them on opposite faces of the two approaching fills. The girder ends were then blocked up on the rock and the barge towed out. After the rock voids near the girder supports had been well filled and allowed to settle, the dumping was proceeded with as before from the track on the girders. When the girders were no longer necessary, they were dismantled and removed.

As to the operation of the dumper, the contractors report that there was no delay from the time the dumper was first installed, except once when the rock embankment settled quickly and for a short time there was danger of a locomotive and cars going into the lake. The dumper was carried when empty by the main barge and pontoons so that there was never any danger of it sinking. The entire cost of the dumper did not exceed 1½ cents per cubic yard for the amount of work done by it, and the equipment is in practically as good shape as when constructed.

The fill was made by Johnson & Carey, subcontractors, under Foley, Welch & Stewart, general contractors for the Canadian Northern Railway. E. S. Johnson designed the dumper specially for the Rainy Lake work and has obtained a patent on the device, the superstructure of which was constructed by the Minneapolis Machinery Company.—Engineering Record.

Tanneries and glue works in the metropolitan sewerage district of Boston all have settling tanks of substantial size. This method of treatment, according to the 1913 annual report of Frederick D. Smith, engineer of sewerage works, has very greatly reduced the amount of sludge material entering the metropolitan sewers and has materially lessened the cost of maintenance of the sewers in this district.

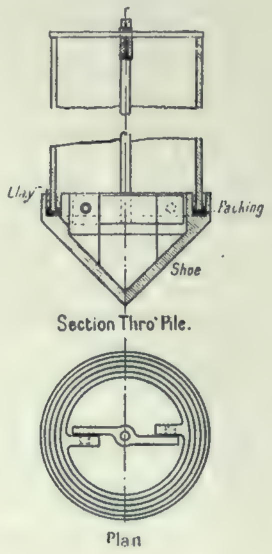
A New Concrete Piling

Semi-Moulded, Semi-Liquid Process Filling All Voids With No Driving

The Engineer

HITHERTO two systems of concrete piling have been in vogue. In the first the pile is moulded, allowed to set and then driven in the ordinary manner. In the other, a steel tube is driven into the ground, then filled with concrete and afterwards withdrawn, the concrete remaining in place. Both systems, in the opinion of many engineers, suffer from defects. In the one case the concrete pile may, they contend, be injured in the driving operation, while when the tube is employed they hold that it is impossible to be certain that the concrete fills the whole space vacated by the tube when it is withdrawn.

A NEW CONCRETE PILING.



Fi. 1
Shoe Attachment.

A system of concrete piling which has been recently designed to overcome these defects, may be described in general terms, as a combination of the two existing methods. First of all a steel tube provided with a shoe is driven into the ground. This tube is then partly filled with concrete in a semi-liquid condition, and a moulded concrete column or pile is introduced into the tube. This may either descend down to the bottom of the tube by its own weight, or force to make it do so is applied if necessary. Simultaneously, the tube is drawn up and the concrete pile remains with the semi-liquid concrete filling the whole of the space originally occupied by the tube and intimately surrounding the concrete pile as well. It will be seen, therefore, that the result is the formation of a concrete pile which is at any rate of the same diameter as the tube—and it may, in parts, be greater, if the ground be soft—while there is certainty that every particle of space is filled with concrete because the weight of the pile itself, in addition, perhaps, to the force used to bring the pile down into position, has ensured this. Moreover, the pile has not had to be driven, in the ordinarily accepted meaning of the term, the forcing process requiring only a steady pressure, which is very different in its effect on the head of the pile to that produced by a falling ram.

The inventor has designed special means for making the joint between the shoe and the tube water and sand-tight, as shown in Fig. 1. Two kinds of packing are used in each joint. One of these is of a fibrous nature, and the other, which is on both sides of the fibrous packing, is plastic, and may he ordinary clay. This packing entirely prevents the entrance of water or sand, so that the tube may be driven down through water without the latter finding its way into it.

Fig. 2 gives sections showing what happens when one of the piles is driven. The left half section of this drawing shows the tube driven into the ground and partly filled with liquid concrete. A cast concrete column has just been lowered on to the top of this liquid concrete. It will be observed that for the bulk of its length this column is of considerably less diameter than the tube, but that it is provided with a collar or flange, which is an easy fit within the tube. As the column descends the liquid concrete displaced by it must necessarily rise in the tube, and it does so until it meets the collar, which it finds some little difficulty in passing, so that pressure is set up. In this way, when the tube is withdrawn, the concrete is forced into the space up till then occupied by the tube. Ordinarily, the flange or collar will be arranged so that when the column is in its final position the collar may be just about at ground level. The position of the column and its flange when the former has reached the bottom of the tube is shown in the right-hand half section of Fig. 2. In this drawing two things will be observed. The first is that the shoe remains in the position into which it has been driven, and forms the foot of the pile, and the next is that the beneath-ground

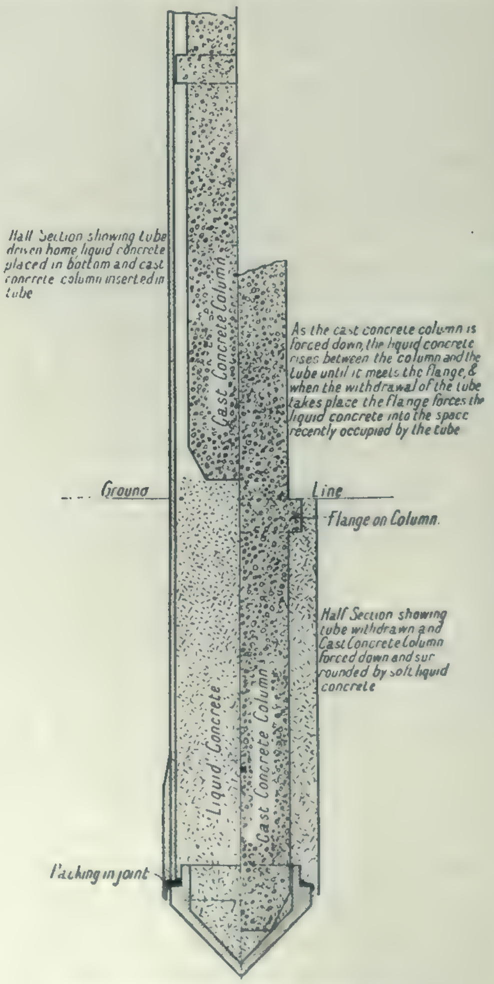

Half Section showing tube driven home liquid concrete placed in bottom and cast concrete column inserted in tube
Cast Concrete Column
As the cast concrete column is forced down, the liquid concrete rises between the column and the tube until it meets the flange, & when the withdrawal of the tube takes place the flange forces the liquid concrete into the space recently occupied by the tube
Ground Line
Flange on Column.
Half Section showing tube withdrawn and Cast Concrete Column forced down and surrounded by soft liquid concrete
Liquid Concrete
Cast Concrete Column
Packing in joint

Fig. 2—Half section, showing operation.

portion of the pile is of considerably greater diameter than is the concrete column or even than the collar upon the column.

Occasionally it may be found that the concrete column will go right home by the action of gravity alone. Generally speaking, however, better results are obtained by means of a device which forces the column down and at the same time withdraws the tube as well.

As the pile descends and the tube is raised, the semi-liquid concrete rises and surrounds the pile and occupies the space taken up before by the tube. A flange on the pile after a time acts as a baffle or rammer on the top of the semi-liquid concrete, and assists in consolidating it and, at the same time, forces it against the surrounding earth.

The Standardization of Horizontal Tubular Boilers

THE question of arriving at a satisfactory method of standardizing the specifications for horizontal tubular boilers has been under consideration by manufacturers in Canada and the United States for some considerable time past. The aim is to arrive at a uniform specification for boiler inspection in order that boilers manufactured in one province or state may be sent to any part of the country and put into operation without subsequent inspection and the attendant risk of incurring a penalty in pressure, so frequently imposed as a safeguard. The problem was discussed in all its aspects before a conference of manufacturers and inspectors which was held at Pittsburg, Pa., in October last and various recommendations were made, of which the following are the more important:

1.—Factor of safety of five.

2.—Fusible plugs in all boilers.

3.—All rivet holes to be reamed. Plates up to and including 5/16 of an inch to be reamed 1/8 of an inch, from 5/16 to 5/8 inclusive, 1/4 of an inch, above 5/8 in. drilled from the solid.

4.—Tube holes to be cut from the solid or punched ½ inch smaller and reamed to size.

5.—The pitch of diagonal braces to be the pitch of stay bolts, plus 2 inches to be the allowable pitch for diagonal braces in the boiler. Pitch to be taken from centre to centre of rivets.

6.—Through rods to be pitched the same as diagonal braces.

The recommendation was also made that horizontal seams of shells be butt strapped in all cases except boilers 36 inches in diameter not exceeding 100 lbs. working pressure, boilers 40 ins. in diameter to have a manhole above the tubes. Boilers above 48 ins. in diameter to have two manholes, one above and one below the tubes, all boilers not having a manhole to have a handhole in the front head.

The desirability of uniformity in the interests both of the consumer and the manufacturer was shown in a paper read before the American Boiler Manufacturers' Association, at Cleveland, Ohio, in September last by Mr. Thos. B. Durban, General Manager of the Erie City Ironworks. Mr. Durban pointed out that the large number of inspection laws had made it almost imperative that the man engaged in the manufacture of boilers for distribution throughout the United States should do his utmost to have the laws so constructed that he did not have to carry a stock of material and stock of boilers on hand to meet the requirements of the various laws in the several states and cities. There was no firm manufacturing boilers that did not suffer from a lack of uniformity in state or city laws. Of all those engaged in making the various types of boilers for distribution throughout the United States and Canada, he ventured the assertion that there were few that had not met with considerable loss. He thought that a concurrent effort among the manufacturers of boilers and mechanical engines, also users of boilers, could not help but bring approximately concurrent legislation. He estimated that there were at least one hundred laws and changes to laws in the United States which alone governed the manufacture of boilers. These could be multiplied by one thousand times as many inspectors as there are laws. The present laws, as enacted, had been of great benefit, having reduced what was frequently guesswork, to something definite and right. These laws were classified as follows:

1.—Group comprising Massachusetts, Ohio, Detroit, Manilla, Chicago, and Indiana. Detroit, Ohio and Manilla laws are practically identical. Massachusetts law differs somewhat and the Chicago and Indiana laws are modifications.

2.—The group comprising all British specifications in which they were interested—British Columbia, Alberta, Saskatchewan and Ontario, all of which were copies or modifications of the British Columbia law.

3.—The group comprising inspection laws—Philadelphia, Seattle, St. Louis, Los Angeles, Montana and others. The laws of this group differed from each other, but in a general way were less complicated than those of the other groups.

All the laws in the United States united on the factor of safety of five, the Canadian laws requiring the factor of safety of five and one-half to six and one-half, but it was optional with the inspector what factor of safety he would accept, depending upon his opinion of the good workmanship that was done and upon how the boiler happened to strike his fancy. The butt-strapped seam was in demand on all boilers, due to the fact that it had been proved to the satisfaction of many people that lapped seams were a menace to the life of the boiler, and many boiler explosions had been attributed by experts to the lack of seams in the longitudinal section. Mr. Durban made a number of recommendations in regard to specifications. The more important of these were that boilers be built on the factor of safety of five, of uniform steel and that the specification over ange steel; that all seams be butt strapped with inside and outside covering straps, that all manholes be 11 by 15 ins.; that no plates be used in the tubular boiler thicker than ⅝ ins.

Inspection Laws in Canada

A conference on Uniform Regulations for the Inspection of Boilers in Canada was held at the Parliament Buildings, Toronto, recently. Representatives of boiler manufacturers from all over Canada, with the exception of Alberta and Prince Edward Island, attended, and the Deputy Minister of Public Works for the Province of Ontario, Mr. R. P. Fairbairn, presided on the opening day. The attendance also included Mr. D. M. Medcalf, Inspector of Boilers, Toronto.

The conference was concerned mainly with a revision of the Ontario regulations for the construction and inspection of boilers.

Section 17 (Sub-Section G) was revised to read thus: "All bridges used for manhole and handhole doors must be wrought iron, cast steel or of pressed steel design, and of ample strength to withstand the stress put upon them. Bridges used for doors not exceeding 3½ by 5 ins. may be cast iron."

Regarding the maximum pitches for rivetted joints, a suggestion was made that the British Board of Trade rules for rivetted joints should be adopted, and Section 30 was amended by the addition of the following footnote: "When the thickness of butt straps is not less than 1-16 ins. in excess of thickness required by Section 41, the value of T in the formula may be increased 1-16 of an inch."

Section 40, governing the distance between rows of rivets, was adopted in its entirety, subject to a few minor alterations.

Section 41 of the Saskatchewan regulations was also adopted instead of Sections 41 and 42 in the Ontario regulations dealing with the butt straps and the full number of rivets in all rows.

Section 43, dealing with longitudinal seams, was replaced by the following Section: "All longitudinal seams on horizontal return tubular boilers must be above the highest water line of the boiler. No longitudinal lap seam of any boiler shall have a continuous line of more than 10 ft., and when the boiler is made of more than one course of plate the longitudinal seams on adjoining courses in all boilers shall not be less than 45 degrees apart, and all plates and boiler shells must be so bent that the longitudinal seam is at right angles to the direction of the fibre of the plate. Butt straps must be cut from plates and not from bars and must be of as good quality as the shell plates."

Inter-Provincial Inspection

Towards the close of the conference a long discussion ensued with regard to the inspection of boilers. It ended in the following resolution being passed on the motion of a British Columbia representative, seconded by a representative from Saskatchewan:

"That while it is very desirable that every effort should be made to establish a satisfactory system of inter-provincial inspection as soon as possible, this conference recognizes that all the provinces are not sufficiently organized, and regrets that until arrangements are made for equalizing the standard of provincial examinations so that the qualifications of inspectors may be similar for all provinces, a complete system of inter-provincial inspection cannot be generally adopted. The conference would strongly recommend that this matter be taken up at once by the individual provinces with any other province where the inspection service is organized, and with the other provinces, as rapidly as they complete their organization, along lines that are satisfactory to the provinces for which boilers are being constructed."

The Construction of Creosoted Wood Block Pavements

By R. S. Manley

A CREOSOTED wood block pavement should show no evidences of wear for many years if the proper materials are used and if they are assembled in the proper way.

The correct depth of base, or foundation, varies with the soil conditions, but the materials forming this concrete foundation and the methods of mixing are in such common use as to be standard and easily secured.

We are interested principally in the construction placed on top of the concrete. The principal causes of defects of more or less serious nature are: (1) irregular or uneven surface, due (a) to careless laying (b) to shifting of sand cushion, (c) breaking or settling of concrete; (2) expansion difficulties due to the entrance of water into the blocks either by way of the joints or from below.

The first (irregular or uneven surface) is death to any paving material because a depression in the surface holds water and repeated churnings of wagon wheels in the depression are bound to cause an enlargement and deepening of the depression.

To avoid "a" the concrete should be mixed quite wet and finished smoothly with a flat wooden spreader, which gives a surface practically as even and uniform as could be obtained by templet. On this should be spread from ½ in. to 1 in. of clean sand, making the sand cushion conform to the contour of the finished street. On this place the blocks quite closely together, roll thoroughly until a perfect surface with no inequalities has been obtained and until the blocks are firmly in place. It will require a great deal of rolling to accomplish this, but the end justifies the means. After this fill all joints two-thirds full of hot bituminous filler of such melting point as is suited to climatic conditions, and spread a thin coating of sand thereon. The use of the bituminous filler is, in my estimation, the most important of all. It converts the street into an effective watershed which, without absorbing any of the water, directs it into storm sewers or other drainage paths. Should any water remain on the surface the wind and the sun, both good evaporative agencies, will rapidly dissipate it.

Now, you have an absolutely even surface waterproofed and converted into a watershed. This surface can not be worn by traffic, because the pressure of wheels is even and regular and there is no dropping or jolting of wheels entering and leaving low spots. The blocks are laid tightly together, so that there is no wearing at the joints. There can be no change in the sand cushion as long as the surface remains intact. It is, in fact, a solid covering of wood blocks cemented together by the filler, and consequently the difficulty of shifting cushion is avoided. It is assumed that the concrete is sufficiently strong so that it will not break or settle. In planning the depth, any error should be on the side of too great, rather than too little depth.

Expansion difficulties are eliminated by the use of bituminous filler, for there can be no expansion without absorption of water, and no absorption of water when all rainfall is conducted quickly to drainage sewers. In addition to this it must be remembered that with the bituminous filler each block is surrounded by an individual expansion joint.

The other way of constructing wood block surface, which is sometimes recommended, is to provide a mixed sand and cement cushion and sand filled joints or interstices. The sand and cement cushion does not give the opportunity for absolutely smooth surface that the sand cushion gives and is considerably more costly. The sand filler in the joints allows moisture to be absorbed in the pavement, and ultimately this moisture gets into the blocks and trouble ensues. It is only on extremely heavy traffic streets that sand can be used as a filler without expecting some expansion difficulties sooner or later. The proof of the pudding is the eating, and the proof of theories of wood block construction lies in the actual occurrences on the street.

It can be stated without fear of successful contradiction that every sand-filled pavement in the South has at one time or other given trouble from uncompensated expansion; and with equal confidence it can be stated that not one bituminous-filled pavement has given trouble from this cause.

Now, there have been objections put forward to the bituminous filler because of the belief that it would produce a sticky surface, disagreeable in warm weather; but if the proper filler is secured, and it is correctly applied there can be no such objection. The suitable filler has a consistency of rubber and can be taken in the fingers, bent and twisted without soiling the the fingers. In applying this filler a spreader with squegee attachment places the filler in the joints where it is needed and not on the surface of the blocks where it is not needed.

It is proper also to use less creosote oil per cubic foot of timber when bituminous filler is used, for the primary function of the creosote oil in this case is to preserve against decay instead of trying to make the creosote oil fill the double role of preservative and absolute waterproofer. No one familiar with preservative methods and history will question the efficacy of 16 lbs. of creosote oil per cu. ft. in preserving against decay for an indefinite period. We, therefore, see that bituminous filler can be used carefully and without inconvenience because of stickiness.

To sum up, therefore, provide adequate smooth concrete foundation, use enough sand to cover any inequalities in the concrete or depth of blocks (except in railway areas and on grades when use sand and cement mixed), lay blocks tightly, roll until smooth, fill joints with bituminous filler, spread coating of sand, and turn on traffic.

Constructional Details in Relation to Lighting Efficiency*

In making the fullest use of day-light there are several factors to be borne in mind. For one, the window area above a certain level must be as large as possible. Fortunately now, through the development of reinforced concrete construction, with its possibilities of slender columns and shallow lintels, and of metal window sash, making possible very large windows with many small panes, yet without appreciably obstructing the light, it is possible to have more than 90 per cent. of the wall space glass. Metal sash, when properly fitted into the concrete, are practically dust and air tight and in this respect possess an important advantage over the old style wooden windows. One manager found that by using these he saved enough on his fuel bill the first winter to warrant the additional investment involved. He was influenced to adopt metal sash chiefly because of their superior fire-resisting qualities. But he found that they had many other advantages not the least of which was that they admitted fully 25 per cent. more daylight.

Window Area and Heating Problems

Large window area was formerly held objectionable on account of the supposedly greater difficulty of heating. With wood frames this objection is doubtless potent. This is because wood cannot be made airtight. It is the heat loss around the frame rather than through this type of window than through a 12-in. properly fitted, are practically leak-proof. In fact, tests have shown that no more heat is transmitted through this type of window tha nthrough a 12-in. brick wall. Double-glazing of the sashes decreases this loss still further, and the maximum result is obtained by duplicating the sashes as well. This is expensive, yet probably preferable to sacrificing any appreciable portion of the wall space available for windows in order to effect a slight saving in heating cost. In fact, accurate analysis in many instances no doubt would show that, from the standpoint of heating economy, double windowing pays. At all events, with metal framing available, there is no valid reason for not taking the fullest advantage of wall area for lighting.

Position of Windows and Lighting Efficiency

Window area close to the floor is almost valueless for lighting. At a height of about 3 feet the light rays begin to be effective as an aid to work and from this point upwards their value increases with each inch. Windows, therefore, should extend very nearly if not quite to the ceiling level, and there is no good structural reason why they should not. If the designers appreciate sufficiently the importance of the upper part of windows for lighting, they can very easily arrange the lintels so that the window frames fit snugly up to the ceiling. The maximum possibilities in this respect are afforded by reinforced concrete construction and in this material by the flat slab, or beam-and-girderless type. In this type of floor, the windows can be extended quite up to the face of the slab, the maximum admission of daylight secured, with no projections on the ceiling to obstruct the light after it has entered. The flat ceilings have a decided advantage, too, when it comes to artificial lighting, particularly if the indirect or the semi-indirect system of lighting is used. The unobstructed flat expanse, when white-coated, furnishes an ideal reflecting surface. Moreover, it permits the placing of fixtures to the best possible advantage, with no limitations on account of beams and girders.

Conserving Daylight

Next in importance to securing the maximum entrance of daylight is the conservation of the daylight after it has entered. Like anything involuntarily trapped, light unceasingly hunts for opportunities to escape. Dark or dirty walls and ceilings furnish such opportunities. The amount of light that will be absorbed in this way is surprising. To offset this loss, therefore, the interior surfaces and all objects within, so far as practicable, should be dressed in white and kept scrupulously clean. One manager found that by adopting such a policy he was able to do without any artificial light for over a month longer than formerly, and when at last the shortening days compelled him to light up, he found that he could get along without the lights, on the average, nearly an hour longer each day than under the old conditions. The saving he made in his lighting bill paid several times over for the expense of white-coating and systematic cleaning.

Much depends upon the kind of white-coating used. When a few years ago the value of white-coating factory interiors began forcibly to be recognized, common whitewash or calcimine was much used, particularly for painting concrete and brick. This has the merit of being cheap and easy to apply; also it is an excellent fire-retardant, which makes it popular for painting wood partitions; but it is not a durable coating. Besides, it collects dirt and dust rather easily and displays an annoying tendency to flake off.

To meet the demand for a better kind of white-coating, cold water and enamel paints containing neither oil nor a varnish have been developed. These are more costly than whitewash, but are so much more durable, as a rule, that they are really more economical.

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* Concrete-Cement Age.

When once an interior has been carefully coated with a good pure white, glossy paint, and care is exercised in keeping it clean, renewal is unnecessary for several years. The cheeriness imparted by such an interior is not the least consideration. It makes everyone feel better towards his fellows and his work, and as a result production is speeded up. So the gain is manifold.

Columns and walls, within the reach of fingers, are usually painted a dark color, so that finger marks will not show. A little light is lost in this way, but the gain in cleanly appearance more than compensates.

It is also important to guard against premature light absorption. If on any side an adjacent building is so close that it cuts off a portion of the direct rays, that building should be painted white. The same holds true of light courts. It is really surprising what a difference it makes to paint a nearby outside wall white. In many cases so doing has rendered artificial lights, towards the end even of the long winter days, unnecessary or necessary for a shortened period of time.

In cases, even with the nearby parallel walls white-coated, the height of these is such, or the space between so narrow, that some further expedient is necessary if the daylight that falls between a pair of buildings is to be manacled and led within. Such an expedient has been developed in canopies or awnings of prism-glass. These intercept the vertical rays of light and divert them horizontally inward. By this means has been lighted many a factory basement which otherwise would have required artificial illumination, by day as well as by night.

Similarly, by glazing the windows with prisms, buildings of low storey height or extra wide extent as compared to the ceiling height have been satisfactorily daylighted.

The Use of Ribbed Glass

Ribbed glass to some extent accomplishes the same purpose, and because considerably less expensive it is much more commonly employed. In fact, its use is favored as a means of diffusing the direct sun rays, regardless of whether or not the horizontal inward-reflecting of the rays is necessary or helpful. Moreover, it accomplishes the purpose of obscuring the view.

At least one factory manager found, however, that the glazing of the lower as well as the upper sash with ribbed glass was inadvisable because the shut-in, prison-like appearance thereby given the factory has a depressing effect on the operatives, further that it increased the difficulty of attracting and holding high-grade men. He stumbled on this objection one day as he heard a workman, who was leaving, give his reason to a fellow-workman: "I am going somewhere where they don't keep you cooped up as if you were in a prison." So forthwith he had the lower sashes glazed with clear glass. After that fewer men seemed to quit without valid reason; and although he figured that some time was lost through the men looking out of the windows, he decided that he was still the gainer by having fewer changes in his force and more contentment.

Width is a limitation only in multi-storey buildings. In one-storey structures the requirements for natural lighting impose no limitations, for dependence no longer needs to be placed on side windows solely. The roof may be skylighted in such a fashion as to make the interior altogether independent of the windows. Lighting by means of skylights is not altogether satisfactory, since the direct rays of the sun, snow in winter time, and condensation combine to make many troubles, aside from interference with the passage of light. Much depends on the slope of the roof. The troubles are a maximum with flat-sloped roofs. With direct sun rays the problem may be over come by the use of ribbed glass, which diffuses the light; and if this is not enough in summer, by white washing or curtaining with white muslin on the sunny side, thus keeping out the heat but not especially impairing the illumination. The difficulty due to condensation may be greatly lessened by limiting the roof slope to 1:3 and extending gutters along the lower edge underneath the skylights; also by running a few heating pipes close to the under side of the lights. The trouble with snow can only be overcome by having the slope steep enough so that it cannot collect on the roof, or by a suitable system of maintenance.

Sawtooth Roof Construction

By far the best way, however, to overcome objections to skylights is to adopt the sawtooth type of roof construction. With this, perfect interior natural lighting may be secured. By facing the sawtooth towards the north the problem of direct sunlight is obviated. The slope of the tooth does away with any snow nuisance and largely with condensation and what small nuisance is occasioned on this score is circumvented by running gutters underneath the notch of the sawtooth and by extending heating pipes in each tooth. Sawtooth construction increases slightly the difficulty of heating a factory; also it is higher in first cost. But when everything is taken into consideration, particularly the fact that this is the only kind of skylight with which it is possible perfectly to daylight interiors, the greater initial cost easily is justified.

Glazed Roof Tile

If, for some good reason, sawtooth construction is not favored, then the maximum results with flat-skylighting is furnished by adopting cement tile for roofing. With these it is possible, by casting plates of glass in the tiles, to have 50 per cent. or more of the roof surface transparent. A very economical skylighted roof is thus secured.

In cases in which the width of the building is not so great as to require sawteeth, very effective natural illumination is secured by making that part of the roof nearest the eaves practically of solid glass —in effect extending the windows upward around the angle formed by the juncture of wall and roof. The width of the strip of roofing to be made transparent is approximately determined by drawing a 45-deg. line from a point within the floor level, at or just beyond the median line of the building, up through the roof. Where this line cuts the plane of the roof determines the innermost margin of the skylights. When so located skylights are much more effective than the conventionel ridge type—unless, of course, the roof is nearly flat or inclined inwardly.

Cleanliness Essential

Keeping the windows and skylights clean is the next important essential to making the most of the illumination nature affords. Neglect to clean the transparencies with sufficient regularity greatly diminishes their effectiveness. Tests made in one instance, in a factory where the windows had not been cleaned thoroughly for months, showed that after a good cleaning fully fifty per cent. more light was admitted. And it is quite possible for 75 per cent. and even a greater percentage to be thus lost. Every speck of dust, however minute, constitutes a light leak. Usually neglect of this kind is due not to parsimony but to lack of a suitable system of maintenance. If to parsimony, nothing could be more foolish, since for every penny saved on cleaning labor at least a dollar leaks out in the artificial light bill, to say nothing of the lessened efficiency of the operatives, due not only to lack of sufficient daylight but to the dispiriting effect of the uncleanly and gloomy condition.

In making the most of daylight there is still another expedient that may be invoked. This is to start to work a half hour or an hour earlier during the period when the days are shortest and artificial lights required the longest. Most would be gained by so doing at the extreme eastern margins of the Standard Time zones; least, at the extreme western. The fact that custom and tradition must be encountered is the only drawback; but concerted action on the part of the manufacturers in one locality should easily be able to overcome these. Within late years there has been considerable agitation both in agricultural and industrial circles for a more logical adjustment of the hours of work with the period of daylight, and it would seem to be worth while on the grounds of economy, for manufacturers everywhere to put themselves solidly back of this change and make it go. One manager, a few years ago, in rebuilding, moved his plant from the eastern part of Massachusetts to Niagara Falls—from the eastern edge of the eastern standard time zone to the western edge—purposely to have the advantage of later dusk, and he found he gained nearly 40 minutes in this way. He could, of course, have affected the same result by starting to work earlier in the old location, but he did not care to combat precedent to that extent. At all events, when contemplating a change in location, it would seem well worth while for the manufacturer to consider this point.

Terra-Cotta in Building Construction

By H. L. Fitzsimmons, Prince Albert, Sask.

IN Europe there are numerous examples of architectural terra cotta which have been exposed to weather for three or four centuries and which are still in good condition, while examples of stonework, subjected to the same conditions, are more or less worn and decayed. There is at the Louvre, in Paris, at the present time, some glazed terra cotta, said to have been made by the Assyrians in the sixth century, before the birth of Christ. In other museums there are some vases and other ancient terra cottas from Egypt and Greece, as well as some famous examples of work made in the Middle Ages, some of which are as perfect as if recently made. All these ancient terra cottas tell the story of durability and proclaim terra cotta to be a material worthy of the genius of those artists of antiquity who wrought so beautifully in this medium.

The Surface of Terra Cotta

The body of all good terra cotta is very much the same, but there are several ways of treating the surface, resulting in products which may be classified as follows: Standard terra cotta, vitreous surface terra cotta, mat-glazed terra cotta, full-glazed terra cotta and polychrome terra cotta. Standard terra cotta has no surface given it, which affects its porosity, a drop of water placed upon it being soon absorbed; it will absorb, also, a great amount of dirt from the atmosphere, and will become very much darker from continual exposure. On some buildings this weathering down is not objectionable; in fact it sometimes lends a charm, producing an antique appearance, which is often very desirable from an artistic point of view. Some one has said that "time is the greatest artist," and, therefore, when it is desired to produce an aged effect, standard terra cotta should be used. It is, consequently, a good material to use for rustic work in connection with country houses, college buildings, gateways, and certain styles of churches. This class of material is made in any color desired.

Vitreous surface terra cotta has a very thin spray of the surface which vitrifies in the burning process, forming a thin glaze which sheds water. This terra cotta will not absorb much dirt from the atmosphere, as the rain of each storm washes it off. It therefore practically retains its original color. This class of material is made in any color desired and is used more than any other kind at the present time, as it seems to satisfy the greatest number of requirements.

In western cities where soft coal is used, and where, consequently, most buildings are cleaned frequently, any material of a non-porous nature is very desirable, and it has been found that glazed terra cotta ranks with the most superior materials in this respect. On this account white glazed terra cotta is used to a great extent in these cities. The lustre of the glaze is deadened for artistic reasons, the glare of the sunlight on full glazed terra cotta being very severe. This is now done in the process of burning, as it has been found that sand blasting the material neutralizes the purpose of the glaze. This method has, therefore, long been abandoned by the leading manufacturers. There are many examples of buildings constructed of this material in the west and the most notable example in the east in the Plaza Hotel, New York.

For light courts, loggias to office buildings, theatres, interiors of railway stations, train sheds and power houses the full glazed terra cotta is preferable, as it helps illumination and gives a more brilliant effect.

The full glazed terra cotta and mat-glazed terra cotta are made in any color required, and when various colors are used on the same buildings, the material is termed polychrome. The various colors may be applied to the same piece if desired, or each separate color may be kept on a separate piece, if the design will permit.

Color of Terra Cotta

Within the past twenty years a great impetus has been given to the production of special colors in architectural clay products. In 1885 fully four-fifths of the terra cotta produced in the United States was red. Now there is less of red used than of almost any other color. Buffs and greys of several shades, white and cream—white are now the prevailing colors. By the use of ceramic colors almost any required tone may be produced, and the effect obtained by using glazed terra cotta of various colors in combination, such as blue, yellow, white, purple, brown, old gold, green or red is often very beautiful. If any particular shade of color not included in the manufacturer's standard samples is desired, the architect should consult with the manufacturer, who will then experiment until the required color is not only produced, but guaranteed to be permanent and free from all tendency to crack. It is generally agreed that there is a great field for this polychrome terra cotta, especially for theatres, restaurants, and buildings of a similar nature, for interiors, loggias, fountains and department stores.

Although the art of using colored terra cotta is very ancient, having been in practice before the Christian era, it is, to some extent, an undeveloped field in this country and offers alluring possibilities in architectural design and construction. It can be used in a very modest and sparing way as well as very profusely; and either in soft tints or in brilliant colors, as the taste of the architect may dictate. Where a rich decorative treatment is required, as in the interiors of public buildings, like our great stations, hotels and theatres, polychrome terra cotta can be employed most effectively and economically. In variety and beauty of tones, terra cotta has now reached a very high standard of excellence, and may be used by the architect to express the highest type of his art. The almost unlimited possibilities presented by the judicious application of colored glazes for exteriors as well as for interiors, has awakened an unusual interest in the use of polychrome terra cotta, a building material with superior qualities of resistance against the deteriorating effects of time and of the action of fire and frost.

Terra cotta is not imitation stone and should not be used as such. It is a material having peculiar qualities which give a distinctive character, and therefore, to be successfully used, it should not be employed in such a way that it will appear as an imitation of, or as cheap substitute for some more expensive material. This may be brought about in several ways. There may be used certain forms and certain styles or ornament more characteristic of terra cotta than of any other material.

One architect has evolved a certain style that he has applied to many buildings, and which is not suitable to any material other than terra cotta. This may be said of both the form and ornamentation of his buildings. The architects of the Flatiron building and of the Wanamaker building, in New York, have successfully used this material for its own sake and not as an imitation. Another firm of architects have used profusely modelled terra cotta to produce highly ornamental effects not so easily obtainable in other materials, and their recent use of colored terra cotta is typical of this material alone. In the West Street building, New York, the architect has made a design distinctly expressive of the material used. This is noticeable in the ornamentation, in the form of cornices and molding, in the coloring and even in the plain shaft of the building. In the Brooklyn Academy of Music the architects have accomplished this result by the use of color.

In regard to the use of terra cotta, it has been said that it is by the use of polychrome terra cotta that the material has its best opportunity for expressing its individual character. It was so in antiquity, in the Middle Ages, and is so at the present time, because polychrome terra cotta is a material complete in itself, and used for its own sake. It cannot by any means be considered an imitation of, nor a substitute for, something better.

Durability of Terra Cotta

The principal value of terra cotta lies in its durability. When made of the right materials and properly burned it is impervious to water, or nearly so. When glazed it is absolutely impervious, and hence not subject to the disintegrating action of frost, which is a powerful agent in the destruction of stone. It does not "vegetate," as is the case with many stones. The ordinary acid gases contained in the atmosphere of cities have no effect upon it, and the dust which gathers on the moldings is washed away by every rainfall. Underburned terra cotta does not possess these qualities to so high a degree, as it is more or less absorbent. Another great advantage possessed by terra cotta is its resistance to heat, which makes it a most desirable material for the trimmings and ornamental work in the walls of fireproof buildings. Although terra cotta has been used in this country for but a comparatively short time, it has thus far proved very satisfactory, and the characteristics above indicated would point to its ranking, in common with the better qualities of bricks, with the most desirable of building materials.

Inspection and Methods of Setting

A sharp metallic, bell-like ring and a clean, close fracture are good proofs of compactness and strength. Perfection of form is in the highest degree essential, and can result only from a homogeneous material and a thorough and experienced knowledge of firing. No spalled, chipped or warped pieces of terra cotta should be accepted, and the pieces should be so hard that they will resist the scratching with the point of a knife. The blocks should be of uniform color also, and all mouldings should come together perfectly at the joints. Terra cotta with a vitreous surface and mat glazed terra cotta should be so non-absorbent that water will lie in drops on its surface without being quickly absorbed. Full glazed terra cotta should be so non-absorbent that ink will not penetrate the surface, and may be entirely washed away with water.

Terra cotta should always be set in either natural cement or Portland cement, mixed with sand, and in about the same way as stone is set. As soon as set, the outside of the joints should be raked out to a depth of three-quarters of an inch to allow for pointing and to prevent chipping. The terra cotta should be built up in advance of the backing, one course at a time, and all voids, except those projecting beyond the face of the wall, should be filled with grout or mortar, into which bricks should be forced to make the work as solid as possible. All blocks not solidly built into the walls should be anchored with galvanized iron clamps, the same as for stonework, and, as a rule, all projecting members over 6 inches in height should be anchored in this way. After the walls are up the joints should be pointed with Portland cement colored with a mineral pigment to correspond with the color of the terra cotta. The pointing is done in the same way as in stone work, except that the horizontal joints in all sills and washes of belt courses and cornices, unless covered with a roll, should be raked out about two inches deep, calked with oakum for about one inch and then filled with an elastic cement.

Disadvantages and Cost of Terra Cotta

One of the principal objections to the use of terra cotta is the time required to obtain it, especially when the building is some distance from the factory. About six weeks are required for the production of terra cotta of the ordinary kind, and the architect should see that all the drawings from the terra cotta work are completed and delivered to the maker at as early a stage in the work as possible, so that he may have ample time to produce it. This will obviate any delay if the architect's drawing and instructions are clear, distinct and complete, as it takes longer to obtain the steel construction work than it does to make the terra cotta. Most of the delay in obtaining terra cotta is really due to the fact that prompt and careful attention is not always given to the preparation of the terra cotta drawings and instructions. Small pieces of terra cotta may sometimes be obtained within two weeks from the receipt of the order, when the molds are already on hand. It is always more expensive, however, to attempt to turn out work in such short order, and inexpedient on account of the risks in forcing the drying.

Terra cotta is generally less expensive than stone, and ornamental work costs in stone about three times as much as it does in terra cotta. Being lighter in weight, the freight charges are less. In large buildings the use of terra cotta reduces the cost of the steel construction, because when it is used on the exterior the steel may be about one-third smaller and lighter, thereby reducing the cost proportionately. This saving is an important item in large structures. The cost of erecting terra cotta is less than that of erecting stone, two storeys of an all terra cotta exterior being sometimes put in place in the same time that it takes to set one storey of stone. The advantage in point of cost in favor of terra cotta is greatly increased if there is a large proportion of molded work, and especially if the moldings are enriched. The use of terra cotta for trimmings, and especially for heavy cornices, in place of stone, often reduces the cost of the walls and foundations, as the weight of the terra cotta will be much less than that of stone, and the walls and foundations may be made lighter in consequence.

Weight and Strength and Tests

The weight of terra cotta in solid blocks averages 122 pounds per cubic foot. When made in hollow blocks 1½ inches thick, the weight varies from 65 to 85 pounds per cubic foot, the smaller pieces weighing the most. For pieces 12 by 18 inches or larger on the face, 70 pounds per cubic foot should be a fair average. The crushing strength of terra cotta blocks in 2-inch cubes varies from 5,000 to 7,000 pounds per square inch. Hollow blocks of terra cotta, one foot high, unfilled, have sustained 186 tons per square foot. From these and other tests I would place the safe working strength of terra cotta blocks in the wall at 5 tons per square foot when unfilled, and at 10 tons per square foot when filled solid with brickwork or concrete. If it is desired to test the strength of special pieces, two or three small pieces should be broken from the blocks and ground to 1-inch cubes, and then tested in a machine. Should the average results fall much below 6,000 pounds the material should be rejected.

Scientific means of accident prevention will be illustrated at the Panama-Pacific International Exposition by an extensive display in the Palace of Machinery of every device ever invited to protect workingmen. Negotiations have been entered into by the Department of Machinery of the exposition with William H. Doolittle, Safety Inspector of the National Trades Association, and the exhibit will be prepared under his direction.

Hydraulic Fill Levees on the Mississippi

THE use of steel slope boards, each about 10 feet long by 18 inches wide and made of No. 14 gauge steel with angle iron top, has made the construction of Mississippi levees by the hydraulic fill system entirely practicable, and in the Trempeleau District about 500,000 cubic yards of work is being done in this way. The boards are placed at the intersection of the side slope with the natural slope of the fill under construction. Several men equipped with shovels distribute the material evenly between the boards, and then move them ahead as the work progresses. The advantage of the slope boards is that levees can be built with any desired width of base and any convenient slope, one layer being added to another until the desired height is reached. Formerly it was thought necessary to deposit a certain amount of solid material on either side of the base before running in the hydraulic fill. This is now entirely done away with. Two separate levees were constructed in the Trempeleau District. The average width of the levee crown is between 8 and 10 feet and the height 14 feet. The slope on the water side is 1 on 3 and on the land side 1 on 2, with banquette against the land side, which is a roadway. The site for the levee was not cleared of vegetation or stumps, it being believed that the hydraulic method of construction would so completely seal the voids around the stumps as to prevent decay. The cost of the two levees was $45,000 figured at the contract price of 8½ cents per cubic yard. Work was begun in May, 1912, and finished in October the same year. In District No. 2, Henderson County, Ill., part of the levees have been constructed in the same way; and in District No. 1 two sections of the levee are to be constructed with the suction dredge. These will have a length of 20,500 feet, crown of embankment 8 feet, with 1 on 3 slopes, both sides, contract price, 11¼ cents per cubic yard. The rest of the levee is to be constructed with a drag line excavator at a price of 12.1 cents. The hydraulic fill levees are built of sand and silt with the sand on top. In the last high water, when the water was within a foot of the top for two days, no seepage was noticeable. With hydraulic fill levees a wide foreshore can be left, and there are no borrow pits left to aid in future seepage and possible failure of the levee. Any side slope can be built. There is no shrinkage, and the levee can be built across an old bayou or marsh with as little trouble as on high ground. The cost of a suitable plant is about $20,000.

Bituminous Concrete

Concerning bituminous concrete the following conclusions by Mr. Linn White, civil engineer for the South Park Commissioners, Chicago, are interesting: (1) Bituminous concrete and bituminous macadam of equal thickness require the same amount of bitumen per square yard. (2) Considering the total thickness of wearing surface and base, and disregarding first cost of plant, the only difference in cost between bituminous concrete and bituminous macadam is the difference in labor, amounting to generally less than 10 cents per square yard. (3) Old macadam is a difficult and uncertain proposition to penetrate with poured bitumen on account of dirty stone, and generally requires a new top layer of stone to produce a successful bituminous macadam, but if of substantial thickness may be utilized as a base for bituminous concrete. (4) The mixing and laying of bituminous concrete may be carried on during damp and cool weather when it would not be practical to construct bituminous macadam. (5) Bituminous concrete is of even thickness and even composition and consequently wears more evenly than bituminous macadam, no matter how well made, and costs less for repair and maintenance. In all these respects the advantage of comparison is in favor of bituminous concrete, except in the one of first cost.

An Interesting Discussion

FROM Mr. Frederick Osborne Smith, F.R.I.B.A., F.R. San. I., we are in receipt of a communication in which he takes issue with our London, Eng., correspondent on several matters discussed under the heading "Engineering Topics in the Old Land," in our issue of July 1 last. Below we give Mr. Smith's letter and also the bone of contention—the article in question.

Ottawa, Ont., July 22, 1914.

Editor "Contract Record,"

The remarks by your London, Eng., correspondent, published in your issue of July 1, referring to fresh air inlets in my article in the Journal of the Royal Sanitary Institute, have no relation to "Drainage and Sanitary Fittings in Canada," neither does my article describe the system I should adopt in England. It does, however, refer to the desirability of abolishing the foul gulleys from our English system which both directly and indirectly cause the bad odors which are unjustly attributed to the fresh air inlet.

The subject to which your correspondent's remarks do apply, is a very vexed one in the Old Country and turns upon the retention or abolition of the sewer gas interceptor. Much of the evidence and the results of experiments placed before the Departmental Committee were not representative of the experience of every-day practice; and it is therefore natural that little or no attention is paid to the Report, as lamented by your correspondent.

Those among us with many years' practical experience in connection with house drainage (not sewerage) will continue to use well-designed and consequently efficient interception with the low level untrapped opening, suitably protected, notwithstanding the severe remarks of your correspondent. Instead of abolishing the interceptor I hope to assist in abolishing the gulleys at the feet of waste pipes which are invariably more filthy than a carefully selected intercepter. The most efficient intercepter that I have seen and which I used nearly twenty years ago, was not among the types experimented with; I fear it would have given too good results. The whole trouble with the intercepter is that in the past the local authorities compelled builders to insert larger traps and drains (with insufficient fall) than were necessary for the small quantity of sewage that was to pass through them, and consequently the pipes became encrusted with grease and sand which periodically breaks away in hard lumps and chokes the intercepter. I know of a case not far from Westminster where the engineer approved a 9-in. intercepter fixed with its outlet higher than its inlet, where a 6-in. trap was specified and amply large enough. Can you wonder that there should be a lack of confidence in the opinions of municipal engineers on matters relating to house drainage?

The various valves mentioned in connection with fresh air inlets are useless and when in good working order are often the cause of serious trouble in other parts of the system. They are also in direct opposition to the by-laws.

Yours faithfully,

Fred. Osborne Smith.

Drainage and Sanitary Fittings in Canada

By F. J. Osborne Smith

THE cold of the Canadian winter renders the adoption of the English methods of sanitation unworkable, and it is therefore not surprising that the Canadians should have adopted the system in use in the United States, where climatic conditions more closely resemble their own. The principal difference between the English and Canadian methods is the abolition of the gullies at the feet of waste pipes and all pipes being inside the building, so that a soil pipe may and often does receive sink and bath waste water and sometimes rain water. This latter depends upon the position of the outlet.

A moment's reflection will enable one to realize that pipes and gullies outside would soon be blocked with ice when the temperature remains below freezing point for weeks together, and frequently below zero.

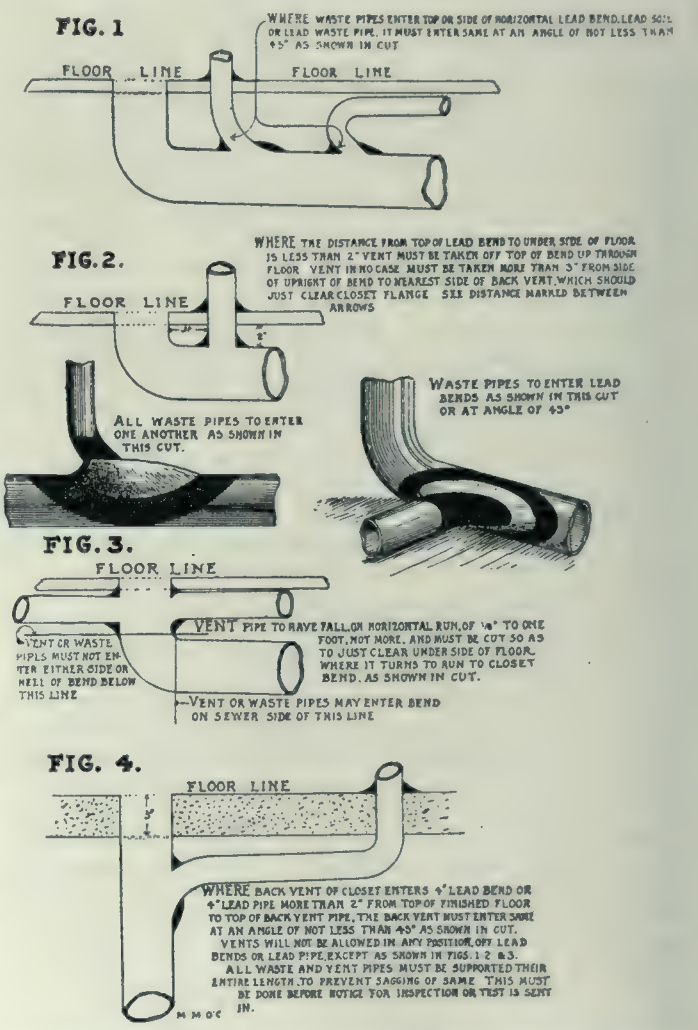


FIG. 1
WHERE WASTE PIPES ENTER TOP OR SIDE OF HORIZONTAL LEAD BEND, LEAD SOIL OR LEAD WASTE PIPE, IT MUST ENTER SAME AT AN ANGLE OF NOT LESS THAN 45° AS SHOWN IN CUT
FLOOR LINE
FLOOR LINE
FIG. 2.
WHERE THE DISTANCE FROM TOP OF LEAD BEND TO UNDER SIDE OF FLOOR IS LESS THAN 2" VENT MUST BE TAKEN OFF TOP OF BEND UP THROUGH FLOOR VENT IN NO CASE MUST BE TAKEN MORE THAN 3" FROM SIDE OF UPRIGHT OF BEND TO NEAREST SIDE OF BACK VENT, WHICH SHOULD JUST CLEAR CLOSET FLANGE SEE DISTANCE MARKED BETWEEN ARROWS
FLOOR LINE
3"
2"
ALL WASTE PIPES TO ENTER ONE ANOTHER AS SHOWN IN THIS CUT.
WASTE PIPES TO ENTER LEAD BENDS AS SHOWN IN THIS CUT OR AT ANGLE OF 45°
FIG. 3.
FLOOR LINE
VENT PIPE TO HAVE FALL ON HORIZONTAL RUN, OF 1/8" TO ONE FOOT, NOT MORE, AND MUST BE CUT SO AS TO JUST CLEAR UNDER SIDE OF FLOOR WHERE IT TURNS TO RUN TO CLOSET BEND, AS SHOWN IN CUT.
VENT OR WASTE PIPES MUST NOT ENTER EITHER SIDE OR HEEL OF BEND BELOW THIS LINE
VENT OR WASTE PIPES MAY ENTER BEND ON SEWER SIDE OF THIS LINE
FIG. 4.
FLOOR LINE
3"
WHERE BACK VENT OF CLOSET ENTERS 4" LEAD BEND OR 4" LEAD PIPE MORE THAN 2" FROM TOP OF FINISHED FLOOR TO TOP OF BACK VENT PIPE, THE BACK VENT MUST ENTER SAME AT AN ANGLE OF NOT LESS THAN 45° AS SHOWN IN CUT.
VENTS WILL NOT BE ALLOWED IN ANY POSITION OFF LEAD BENDS OR LEAD PIPE, EXCEPT AS SHOWN IN FIGS. 1 2 & 3.
ALL WASTE AND VENT PIPES MUST BE SUPPORTED THEIR ENTIRE LENGTH TO PREVENT SAGGING OF SAME THIS MUST BE DONE BEFORE NOTICE FOR INSPECTION OR TEST IS SENT IN.
M M O'C

Where lead pipe is used for water or bent pipe it must be supported with boards when run on the horizontal, and with tags soldered to pipe when run vertically.

The omission of gullies which receive sink and bath water appeals to me very much, especially now that I have had actual experience of the system, and I am convinced that it is more healthy than the foul and evil smelling gullies in England. It behoves sanitarians to give this matter careful thought and attention with a view to removing these defects in the English system of house drainage.

The accompanying diagrams are supplied by the Local Board of Health, Ottawa, to licensed plumbers to explain the by-laws regulating plumbing. They will help to illustrate the following notes.

Eaves gutters with rain water pipes are seldom used, but other rain water pipes are trapped at their feet before they connect with the drain. Access to the trap for cleaning is provided by a 4-inch brass screw cap.

Drains inside the building and to three feet outside are usually made of iron pipes jointed with gaskin and blue lead, laid to a fall of 1 in 48. Junctions must not have a greater angle than 45 degrees. The following table gives the weights compared with London County Council weights:—

Diameter.	L.C.C. Soil pipe.	City of Ottawa.	P.W. Dept. Canada.	L.C.C. Drain pipe.
6″	16	15	20	25½ lbs. per foot.
5″	11½	13	17	21 lbs. per foot.
4″	9	9	13	17¾ lbs. per foot.
3″	—	6½	9½	12 lbs. per foot.
2″	—	4	5½	— lbs. per foot.

The usual length of each pipe is five feet, and it has the weight stamped on the outside. The pipes are coated to prevent them from rusting.

Intercepting traps are optional in Ottawa, and when used must be placed inside the house wall with a cleaning cap; provision must be made for ventilation (F.A.I.) and a cleaning junction beyond it with brass screw cap, and the trap must be an approved design.

Brick chambers are rarely necessary, as the trap and cleaning junctions are generally in the cellar.

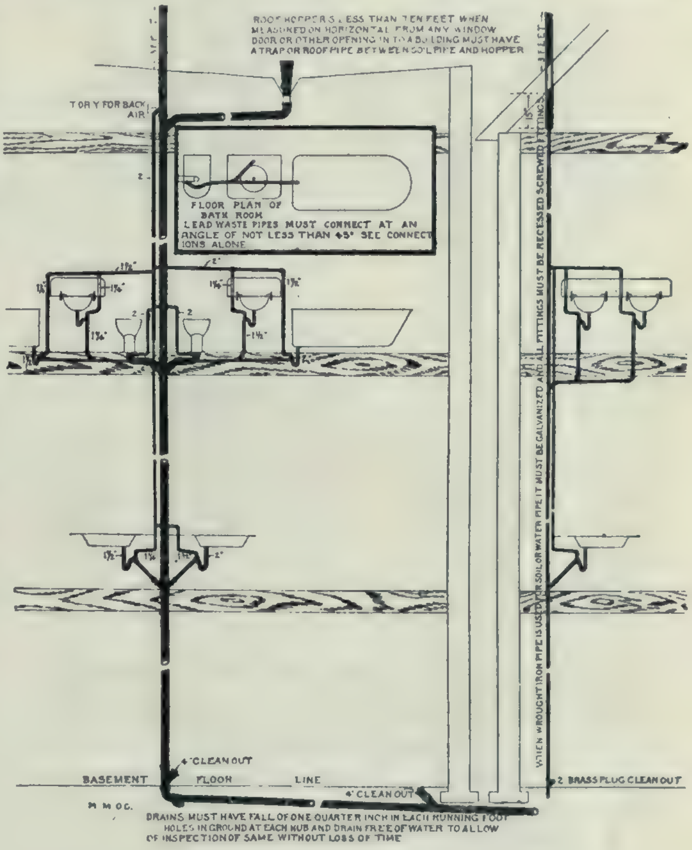
Fresh air inlet is 4 ins. diameter, and connected near the trap, and taken outside and fixed as far as possible from any opening into the house, terminating at least 18 ins. above ground, and left open or covered with a cap having an area of one-fourth more than that of the pipe. When left open they are usually fitted with a semi-circular bend, fixed vertically.

Soil pipes are fixed inside the building, and are iron pipes of similar weight to the drain pipes. They extend from the drain to the top floor ceiling, where they are enlarged one inch in diameter, and continued through roof to 3 feet above, and the end of the pipe bell-mouthed and fitted with a copper cap. The increase in diameter is to allow for the vapour condensing and freezing on the interior of the pipe, which would otherwise cause a reduced internal diameter. At the feet of the vertical pipes a rest bend is fixed, supported upon a stone slab, and immediately above the bend is a junction with brass screw cap for access and cleaning. Similar junctions are fixed on the horizontal runs also. Branch soil pipes are made with 4-inch junctions for connecting to each w.c., and 2-inch junctions for connecting to each waste from basins, sinks, baths, etc., and a 4-inch junction on each branch for cleaning, with a heavy brass ferrule leaded into socket, with brass screw cap having 1½-inch square nut 1 inch high.

Antisyphonage pipes are connected to soil pipes below the lowest fitting and carried up through roof, and treated as soil pipes with all necessary junctions for connecting vents from w.c.'s, baths, sinks, etc. Every fitting must be supplied with a trap and ventilating pipe to prevent gas from sewer, drain, or soil pipe escaping into the building, and the trap must be fixed as close as possible to the fitting. No fitting is allowed to drain through more than one trap, the intercepter only excepted; the vent is not to be less than one size smaller than the trap, and no vent less than 1¼ inches. The vent from three w.c.'s is usually 2 inches, but when more than three a 3-inch pipe is required. All vent pipes must continue to rise after leaving a trap, and must not be less than 4 inches where they pass through the roof. Wrought iron pipes with steam fittings may be used for vent pipes from traps, or sometimes lead is used, but the weight is light compared with that used in London. I understand that lead pipe is expensive in Canada.

Rain-water pipes, when carried inside a building, which is usual, are of the same iron pipe as used for soil pipes and drains; this is only to be expected when it is remembered that in some cases they are not trapped at their feet, but connect direct into the drain.

Water closets are almost entirely of the syphonic type, with one trap and concealed outlet, and many have the syphon-jet-discharge. A pail of water will start the discharge and leave the seal reduced but not broken (about 1-inch seal remains); this is an extreme case, but in ordinary use the after flush charges the trap to its full capacity. The flushing cistern for these closets seems to have a capacity of about five gallons, which is extravagant and wasteful. The concealed joint is hardly desirable, except for appearance. It seems to be a reliable one that is used here. A brass collar with an internal thread is wiped into the lead branch, and a brass fitting is securely cemented into the fireclay of the pedestal; upon this brass fitting an external thread is cut, and the joint is made by screwing the two together.


ROOF HOPPERS LESS THAN TEN FEET WHEN MEASURED ON HORIZONTAL FROM ANY WINDOW DOOR OR OTHER OPENING IN TO A BUILDING MUST HAVE A TRAP OR ROOF PIPE BETWEEN SOIL PIPE AND HOPPER
T OR Y FOR BACK AIR
2
FLOOR PLAN OF BATH ROOM
LEAD WASTE PIPES MUST CONNECT AT AN ANGLE OF NOT LESS THAN 45° SEE CONNECTIONS ALONE
1½″
2″
1½″
2
15″
WHEN WROUGHT IRON PIPE IS USED FOR SOIL OR WATER PIPE IT MUST BE GALVANIZED AND ALL FITTINGS MUST BE RECESSED SCREWED FITTINGS
4″ CLEAN OUT
BASEMENT FLOOR LINE
4″ CLEAN OUT
2 BRASS PLUG CLEAN OUT
DRAINS MUST HAVE FALL OF ONE QUARTER INCH IN EACH RUNNING FOOT HOLES IN GROUND AT EACH HUB AND DRAIN FREE OF WATER TO ALLOW OF INSPECTION OF SAME WITHOUT LOSS OF TIME

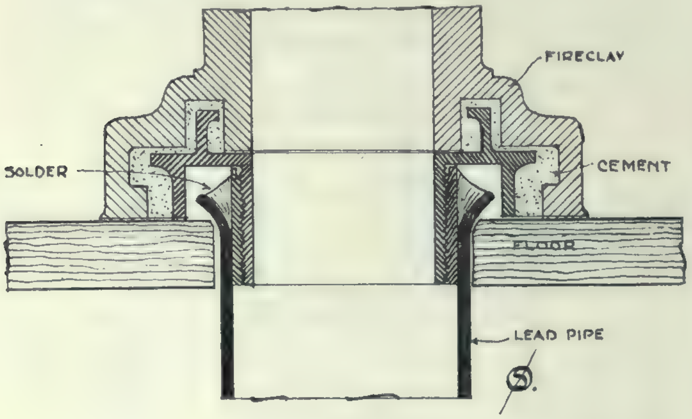
The iron drain shall extend through the wall.

Lavatory basins, baths and sinks are generally made of enamelled cast iron. The enamel is of very good finish. The brass work is all plated, also the grating in the kitchen sink, traps and waste pipes above the floor. The supply taps for baths are smaller than we use in London, and are joined together with one centre outlet, fitted to receive small rubber tube for hand shower, etc. As the supply of both hot and cold water to the fittings is often under the full pressure of the main supply, the snall taps are not as inconvenient as they would be if a cistern intervened.

It seems very queer to see the cold water main connected direct to the top of the hot water cylinder, but it obviously must be carried down inside. There is no air pipe, nor is there a safety valve, as any pressure is supposed to relieve itself into the main, but in the event of the stopcock being closed I fear something would happen.

Urinals are generally the old-fashioned lip basin pattern, but the stalls in one piece of fireclay are beginning to be recognized as far superior.

In conclusion, I should like to mention a very interesting gully that is used in toilet rooms and cellars for floor drainage. It is a cast iron gully with a flushing rim, and a connection at the bottom of the trap through which a jet of water can be directed to remove the sediment at the same time that the sides are being washed by the water from the flushing rim.



Both hot and cold water are connected to these gullies with stopcocks to control the supply.

There are many interesting points in the system of house drainage in vogue here, and I feel sure that some of the arrangements might be adapted to our conditions at home, and in many instances would not only simplify, and thereby increase efficiency, but also reduce the cost, which is an important factor in any system.

The Design and Construction of Intercepting Sewers, with Special Reference to Minimizing Infiltration

Although many sewerage engineers consider extremely flat grades practicable for intercepting sewers, because of the depth of flow and the macerated condition of sewage on reaching intercepters, an occasional warning against too flat grades is sounded. Thus in a paper before the American Association for the Advancement of Science, Mr. J. N. Ambler, of Winston-Salem, N.C., urged the advisability of utilizing all the available fall. The following excerpts from the paper, relating chiefly to the minimizing of infiltration, are published by Engineering and Contracting:

All the sand, mud and illegitimate matter of all kinds which enter the collecting sewers is pushed down their shaper grades and is finally deposited in the intercepter.

The writer once removed some twelve or fifteen hundred bushels of such substances from about half a mile of old intercepter. Most of this was sand, but bottles, rags, straw hats, overalls, stones, wooden articles, etc., were present, and the capacity of the sewer was greatly reduced.

Of course, hard and fast rules cannot be laid down, but the writer does not approve laying a grade as flat as 1 ft. per 1,000. It is his endeavor, in the light of experience with cleaning, to get all the fall possible.

From the very nature of the low level intercepter, it is usually located where the ground is alluvial, and with the ground water level near the surface. In many cases the ground to be traversed is marshy, and in nearly every instance the sewer is laid below the ground water level. These conditions are distinctive for intercepters and require special methods of treatment.

Unless the joints are laid very perfectly and are so maintained at the flat grade as to utilize all the fall, without pockets, the infiltration of ground water will be so great as to greatly reduce the carrying capacity of the sewer, or even, in the case of a long line, to completely destroy its usefulness.

Settling of the joints will, of course, render the conditions worse, and may result in the inflow of quicksand until the sewer is put out of commission, as in a case which once came under the writer's charge for correction. It is, therefore, of the utmost importance not only to have perfect joints, reducing the inflow of the ground water to a minimum, but also to provide means to maintain the grade as a perfectly straight and rigid barrel, free from settlement.

The difficulties of meeting this last requirement are often very great, as usually the bottom of the trench is a water-soaked quagmire and frequently quicksand.

Considering, first, the question of perfection in the joints, the writer has specified a mortar or neat Portland cement, on account of its density and imperviousness. The shrinkage of neat cement mortar being considerable after the mortar is set, a wash of thick grout is used to fill the cracks. The entire circumference of each joint is rigidly inspected by hand, and no imperfect joint is left on the work.

Special compounds, as melted sulphur, and the various elastic compounds from which it is claimed that perfect joints may be made, even in water, were not tried, either on account of the expense, or because there was doubt felt as to the durability of such substances.

Feeling the necessity of having some criterion upon which to base the engineer's acceptance of the work, so far as ground water is concerned, the writer read up all available data on ground water flows, and came to the conclusion that it is a subject about which too little is known, and that many of the existing data are conflicting.

There should, however, be some criterion to apply to work done by contract, and it seemed that nothing better could be done than to determine how much water the sewer might be allowed to carry without materially injuring its usefulness. The criterion should not be so severe as to greatly affect contractors' bids. Such a criterion, it would seem, should be based upon the number and circumference of the joints.

The following clause appears in one of the writer's specifications, and is offered for what it is worth, until something better can be substituted. It at least has had the effect of securing some very careful work, and contractors were not disposed to regard it as severe when it was thoroughly explained to them.

The clause is as follows:

It is the intent of these specifications that no more leakage of ground water into the sewer be allowed than is admissible with a first-class piece of work, in which care has been exercised to get as near as possible to a water-tight result.

To determine the admissible amount of leakage, the length of a joint will be considered as the outside circumference of the spigot end of a pipe.

Leakage not in excess of 2 gals. per day of 24 hours for each foot of circumference of every joint will be considered admissible, the amount of flow to be determined by the engineer's gaging in each section, by means of a notch board.

The contractor agrees that for each 10,000 gals. per day of 24 hours by which the total flow of sewer exceeds what the total flow should be, when figured on the basis already given, a deduction of $100 from the contract price will be made.

This will not apply further than to a total flow resulting from 3 gals. per day of 24 hours, from each foot of joint length, beyond which figure the sewer will be regarded as not in compliance with this contract.

The writer's opinion is that the above requirement is a very mild one, as he once laid a mile of large sewer through exceedingly swampy land, passing under several streams, etc., with a result that not more than a stream ¼ in. deep was flowing in the bottom of the pipe at the lower end on completion. However mild the criterion may be, it has had a powerful effect against bad work.

It is extremely important that the manholes should not leak. To prevent this, the best hard bricks are used, each being dipped in a pail of water, as handed to the mason. The brick work rests on a cement bottom 12 ins. thick with a solid cement invert and the contact of the pipe with the masonry is an object of especial care. Manholes are built up sufficiently high above the meadow to prevent being stopped by floods. The caps are secured to the covers by two set screws to prevent malicious persons from placing foreign substances in the sewer.

The handling of water in the trench during construction is usually less serious than the inexperienced are apt to imagine. A diaphragm pump connected to a small gasoline engine is the cheapest and best way known to the writer for removing the water. A small trench is excavated along the side wall of the main trench which conducts all accumulated water to a pump, where it is promptly removed by pumps, without being allowed to rise on the freshly constructed sewer line.

The writer has used the pile and platform method of founding, and finds it of very general application, of moderate cost to handle, and very satisfactory in result. Two piles, 4 by 4 ins., bluntly sharpened, are driven opposite each other in the trench. Two more piles are driven at a distance of 2½ ft. up the trench, and so on, wherever a thoroughly firm bearing for the sewer cannot be found. Across the heads of these piles a 1 by 4-in. batten is spiked, and a platform of two 1½-in. planks is laid on and spiked to the various battens over each pair of piles.

Piles are driven to practical refusal by means of a rammer, consisting of a cast iron disc 8 ins. in diameter, 3 ins. thick, into the centre of which a 2-in. iron rod is screwed. This makes a very heavy rammer, resembling the piston rod and head of a steam engine. It takes three or four strong men to operate it, but it is the quickest and most economical way the writer has been able to find for this work.

The piles vary in length from 18 ins. to 9 ft. Even where the short ones are used, the ground being tolerably firm, a far superior foundation results than is to be had by laying loose planks in the bottom of the trench.

The platform was laid to a more or less regular grade about 0.3 ft. below the flow grade of the sewer, the pipe being supported in a cradle of two wedges cut from opposite sides until the flow line was precisely at grade.

The wedges were then spiked to the platform to hold them in position, and about ½ gal. of concrete was placed behind them to prevent a tendency for the back-fill to crush the pipe.

Sand and Coarse Material and Proportioning Concrete

By John A. Davenport, M. Sc. and S. W. Perrott, Professor of Civil Engineering at Liverpool University.

In correctly made concrete the amount of sand should be just sufficient to fill the voids in the coarse material, and the amount of cement just sufficient to fill the voids in the mixture of sand and coarse material, and to coat all the particles with very thin jointing layer. It is a rational assumption that such concrete will give a maximum of strength with the minimum of cost, and if this assumption be justified by experimental results, it follows at once that the proportioning of concrete-forming materials is of the utmost importance. Greater strengths can be obtained by the use of excess of cement, as in the case of the ordinary mix of 1:2:4, but the increase in strength is less than the increase of cost of materials, and is, therefore, only justified in particular cases.

The strength of any concrete will depend not only upon the materials and their proportions, but also upon the method of using those materials. Any void in a mass of ¾-in. coarse material may be filled in many ways. First, it may be filled with cement and sand and mortar, as in the 1:2:4 concrete; secondly, it may be filled with a piece of stone which practically fills the whole space; and, thirdly, it may be filled with a number of stones which vary in size with a minimum amount of cement-and-sand mortar. The first filling is composed almost wholly of joints, and on that account is weak; the second filling is strong, owing to the absence of joints, but it is impracticable; but the third is a compromise which is not only practicable, but also strong. It will be seen that the amount of the variations in size or the grading will depend upon the nature and quality of the work required. On the one hand there will be good but costly filling, and on the other a cheap but still good filling, and whether the graduation be large or small the filling will be better than one of cement-and-sand mortar only.

With a view to testing the effect of proportioning upon the strength and other properties, and also the cost of concrete, the authors drew up a series of experiments, the intention being to test compressive strength, modulus of rupture, specific gravity, water resistance and fire resistance. Various difficulties arose in the course of the work which not only prevented the paper being presented on the original date, but prevented also the inclusion of specific gravity, water resistance and fire resistance tests. The series involve 216 test pieces, to which must be added others prepared for water and fire resistance and specific gravity tests, but which could not be tested in the time available. The voids were measured in a patent apparatus designed by Mr. Davenport, which gives results to 1-5 of 1 per cent. The preliminary data comprised tests on Portland cement, size of granite chips, volume of chips per batch, percentage volume of voids in chips, sizes of river sand used, volume of sand used per batch, percentage volume of voids in sand, and the volume of cement used per batch. Regarding the last-mentioned item, it must be noted that no allowance was made for the excess cement required for jointing, only the amount required to fill the voids being used. , Had time permited it, the correct allowance in each case would have been ascertained, and additional tests made therewith. The limited time made it impossible to test the cement before using it for the concreted test pieces, the brand only suggesting its probable good qualities.

The batches were hand mixed by engineering (senior honours) students, and as no special means of testing the thoroughness of the mix were adopted, the resulting concrete will probably compare favourably with machine mixed so far as uniformity of results go. Every care was exercised, however, in the mixing to get all the materials thoroughly intermixed and apparently uniform. This proved to be the case when the specimens were tested. The moulds were made of planed boards, bolted together with gangs, damped before using, and lined with paper on the under side to facilitate removal. In spite of this, several pieces were damaged in removal, due more particularly to the relatively small sections used.

Immediately after mixing the moulds were filled and left in a tool shed till required for testing. They were wetted regularly every three or four days.

It was found that the ratio of compressive to tensile strength varied more in the one-month than the three-month tests, and is not sufficiently uniform to base any conclusions upon beyond the fact that such ratio is not constant. It is considered by the authors, however, that this ratio should be more or less constant as the failure, whether compressive or tensile, depends upon the adhesive strength of the cement.

The ratios strength at three months to strength at one month were more or less uniform, more particularly in the case of compressive strengths. In the case of 1:2:4 concrete the modulus of rupture appears to increase more rapidly than the compressive strength, while in the other series with cement accurately proportioned, the compressive strength increases more rapidly than the modulus of rupture, as out of six series only one runs the other way, probably due to rather dry mixing of those three-month test pieces.

Although the cement tests are unsatisfactory, it will be possible to compare the strength and costs of the concrete in the different series, as they will probably all be affected to the same extent. The most important point brought out by such comparisons is the fact that for accurate proportions, the ratio of the cost of the cement compared with the total cost is practically constant for all gradings taken in the tests, so that when the graded coarse material is used the total cost need only be further considered. Of course, the total cost is always the final criterion as regards economy, and it may be suggested that the ratio cost of cement to total cost need not be considered. But the relative values of total cost obtained may be altered when additional tests are made at other ages, and it is difficult to say whether they will be affected by the ratio; so that, if it can be shown conclusively that this ratio is constant, or nearly so, the total cost, age and proportions need only be dealt with.

The San Gabriel River bascule bridge near Los Angeles has a 187-ft. Scherzer rolling-lift bascule span with double-web segmental girders weighing 55,000 lbs. each. The flanges curve through an arc of nearly 90 deg. with a radius of more than 30 ft. and were planed by an ordinary machine-shop lathe with its tool-stock connected to the girder by a cable. The girder was laid flat on a pair of curved rails and rigidly attached by timbers to a pivot in a small concrete pier at the centre of the curve. The cable was arranged so that the feed of the lathe would pull the girder in a circle around the centre of the curve. By means of its adjustment and a belt from a motor over a large pulley the lathe was given a very slow speed and pulled the girder against the tool of a milling machine, which accurately finished the curved surface. The work was supervised by Samuel Murray, bridge engineer of the Oregon-Washington Railroad & Navigation Company, and was described by him in a paper on "Some Types and Features of Movable Bridges," presented to the Pacific North-west Society of Engineers.

Status and Prospects of the Steel Trade in Canada

The present status and future prospects of the Canadian steel trade are the subject of an interesting article by a correspondent of the London "Engineer," who writes:

"After many ups and downs the Canadian steel industry seems to be entering upon a more settled and prosperous career. It is only some twelve years since Canada's iron and steel making resources were described as inferior on very high authority, but recent discoveries of rich and well-situated deposits of coal and iron ore have improved the outlook. These discoveries, coupled with changes in the tariff, the appointment by the government of a special commission to consider the question of renewing the iron and steel bounties, with a fairly reasonable prospect that they will be renewed, and the building of large works by the American Steel Trust, together with extension by the existing Canadian companies, are circumstances seeming to combine to give the Dominion's industry a new lease of life.

"In spite of liberal government bounties from 1884 to 1910, and in late years a fairly high protective fiscal policy, the financial results of Canadian iron and steel enterprises have been very poor. But now the signs of a complete change are fairly abundant, while the erection of vast works by the American Trust is both interesting and significant. The Steel Trust people have had one or two bad disappointments in Canada. About ten years ago the Canadian Government was thinking of putting a tariff of $7 per ton on imported steel rails. At that time the native steel industry was assuming considerable proportions, two or three large rail mills being in course of erection, but these concerns were threatened by an American Steel Trust "dumping campaign." It was then that the Dominion Government added its famous "anti-dumping" clause to the Tariff Act. In consequence of that notable clause, the Steel Trust directors began to consider the question of erecting works of their own within the Canadian tariff wall. Even at that time the Trust was exporting 200,000 tons of steel products to Canada annually. Not only was it a question with the Trust of saving the import duty by producing for the Canadian market in Canada instead of the United States, but there was the added prospect of enjoying the bounties on iron and steel production that were paid by the Canadian Government. For example, a bounty of $1.70 per ton was paid in respect of the production of pig iron, with an additional $1.05 on raw steel, and higher payments in respect of more highly finished goods. But when the Steel Trust appeared in Canada and purchased 1,000 acres of land at Sandwich, Ont., a fear was inspired that the struggling Canadian enterprises might be squeezed out by the big Trust from the States. There was certainly a danger that the American Trust would manipulate the Canadian tariffs and bounties not only to strengthen its position in the Dominion market, but for the purpose of fostering an export campaign. Had that idea materialized it would have been rather serious for the British steel trade. We should have had the spectacle of American Steel Trust exports from Canada, substantially bounty-fed by a British Colony, competing with British products in the world's markets.

"It was then that Canadian statesmen, put on their guard, introduced a new and notable feature in the bounty law. In introducing the Bounty Bill in 1907, the Finance Minister, Mr. Fielding, laid down the new policy as follows: 'We propose,' he said, 'that these bounties shall not apply to iron and steel that is exported. There are rumors that the great Steel Trust of the United States may come to Canada to do business. If it comes in the ordinary way, well and good; but if it comes here to make iron and steel for export, it may add largely to our burden. We think it is well to have it understood that we are giving these bounties for the encouragement of iron and steel production for consumption in Canada, and if any concerns undertake to export iron and steel goods they shall not be entitled to the bounties on them.'

"Had it not been for that special stipulation, it is almost certain that the Steel Trust would have immediately proceeded to erect works in Canada, and would before now have been exporting bounty-fed steel goods into this country, among others. In all the Bounty Acts prior to the appearance of the American Trust on the scene—that is to say, in all the Bounty Acts between 1883 and 1903—the provision was simply that payments be made in respect of certain iron and steel goods produced in Canada. The export trade was not considered, for with the exception of a small quantity of pig iron sent to Scotland in 1897 nothing of this kind was exported from Canada; but the advent of the big American Trust altered the situation, and it was therefore provided in the next Bounty Bill—that of 1907—that the bounties be paid only in respect of goods consumed as well as produced in Canada. Most of the bounties terminated in 1911, owing largely to the opposition of the farmers, the general idea being that the steel industry could support itself, and there was no renewal of these special favors. But in response to a persistent agitation by the Canadian steel manufacturers, the Government has appointed a special commission to inquire into and consider the question of a re-introduction of the bounty system. After a great deal of uncertainty, the steel tariff has been placed upon a reasonably protective basis, and it is not altogether unlikely that the manufacturers will again enjoy bounties, for Canadian statesmen are anxious to see the mineral as well as the agricultural resources of the Dominion developed.

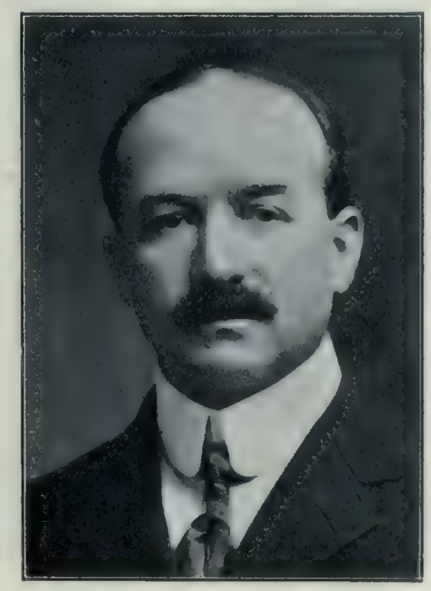
"The stipulation by the Canadian Government in 1907 that the bounties were not to be paid in respect of any goods that might be exported, coupled with the probability that the bounties would not be renewed in 1911, upset the designs of the American Steel Trust, and the proposed Sandwich enterprise stood in abeyance, although Mr. Farrel tried to persuade his co-directors to proceed with the business in 1909, contending that unless the Trust began to manufacture for the Canadian market within the Canadian tariff wall their share of the trade in the Dominion might be lost to the rapidly growing works of purely Canadian concerns.

"Mr. Farrel's advice was not taken at the time. Now, however, it is announced that the American Steel Trust is to spend at least $20,000,000 in erecting modern blast furnaces, steel works, and rolling mills on the Sandwich site. With vast reserves of coal and iron ore and a rapidly growing market, it may be that within the next generation there will be built up in Canada an iron and steel industry second only to that of the great United States."

Canadian Contractors and Their Work

Mr. Wm. Lyall

MR. William Lyall, the president and managing director of the P. Lyall and Sons Construction Company, Limited, Montreal, is a Scotchman by birth—he was born in 1866 in Castletown, Caithness—but has lived the greater part of his life in this country. He was brought to Canada by his father, the late Peter Lyall (the founder of the firm) at an early age, and was educated in Montreal. He has been connected with the building trade all his business life. In 1881 he was appointed to his father's business, and continuing in the same line, was made managing director of the firm, then known as P. Lyall & Sons, Limited, of which the late Mr. P. Lyall was president. When stock in the enterprise was open for public subscription the name was changed to its present form. Mr. William Lyall was elected president, and is now head of the largest contracting firm in Canada. Mr. Lyall is a very busy man, for he is a director of the Sterling Bank, managing director of the National Brick Company, director of the City Land Company, president of the Wallace Sandstone Quarries Company, director of the Ontario National Brick Company, besides being financially interested in many other leading Canadian corporations. He is a member of the following clubs: The Manitoba, Winnipeg; the Engineers, Canada, Caledonia Curling, St. Lawrence Yacht and Beaconsfield Golf, all of Montreal; also of the M. A. A. Association and the Masonic Fraternity. In addition, Mr. Lyall is a member of the Montreal Board of Trade, and a trustee of the Western Hospital. He is married, and has six children.


Mr. Wm. Lyall, Contractor, Montreal.

At Edmonton, operations have commenced upon an addition to the hospital at an estimated cost of $120,000. The architect is Mr. R. W. Lines and the general contractors are Messrs. Olson & Johnson, Edmonton. The addition is to be three storeys high, of brick construction.

Construction is to start immediately on an office building estimated to cost $600,000 for the Prudential Trust Company, Limited, Winnipeg. The building will be thirteen storeys high, of stone, steel and reinforced concrete construction. The architects are Messrs. Ross & Macdonald, and the general contractors Messrs. Carter, Halls-Aldinger Company, both Winnipeg firms.

The Late Dean Galbraith

It is with profound regret that we have to announce the death of Dr. Galbraith, Dean of the Faculty of Applied Science of the University of Toronto, which occurred suddenly at his summer home on the Georgian Bay on July 22.

The late Dr. Galbraith was a man whose genial, unassuming personality had endeared him to two generations of engineers. Only last December, members of the profession from all parts of the North American Continent gathered together in the Engineering Building of the University of Toronto to pay tribute to his worth and work on the occasion of the fiftieth anniversary of his entrance as a freshman. Upon that occasion one of the speakers aptly referred to him as "the Dean of Engineering in Canada." It is in this sense that Dr. Galbraith will best be remembered.

The late John Galbraith, M.A., LL.D.

Dr. Galbraith was born in Montreal in 1846 and received his early education at Port Hope, Ont. Entering the University just fifty-one years ago, he graduated B.A. in 1867 and M.A. in 1868. Since that time the honorary degree of LL.D had been conferred upon him by a number of universities. His early engineering experience was obtained on engineering and survey work on the Midland Railway as assistant to the Chief Engineer. Later he was engaged on Intercolonial Railway construction. In 1878, upon the founding of the School of Practical Science, he was appointed to the Chair of Engineering. He became Principal of the School in 1889 and retained that post until 1906, when he was made Dean of the Faculty of Applied Science. He was one of the founders of the Canadian Society of Civil Engineers and was President of that body in 1909. A signal honor was conferred upon him a few years ago when he was made a member of the Quebec Bridge Enquiry Commission.

The late Dean Galbraith was a man of that genius which has been described as "an infinite capacity for taking pains." This capacity exerted in his earlier days gave him in his later years the mature judgment which placed him in the foremost ranks of the engineering profession. He was known to engineers old and young from one end of the country to the other and was beloved by all. His disposition had never become warped by close application to academic or professional work and he had at all times that human touch which is productive of affection which few men enjoy. He was always charitable, always patient.

For some time the late Dr. Galbraith had been failing, but the shock of his sudden death was little less acute. His place on the University staff will be hard to fill, while the vacancy which he has left in the hearts of countless engineers from coast to coast will never be filled. The name of John Galbraith will occupy a place by itself in the annals of engineering in Canada.

Personal Mention

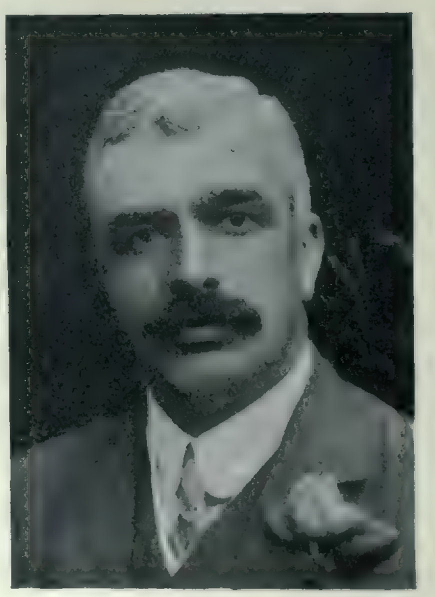
Mr. M. C. Macfarlane has resigned the position of Resident Engineer of the Montreal aqueduct extension.

Mr. John M. Ver Mehr, head of the John Ver Mehr Construction Company, Toronto, is at present on a business trip to England.

Mr. Chas. Harper, B.A., has been appointed professor in charge of the Department of Science at Moose Jaw College. He was formerly attached to the Research Laboratory of Queen's University, Kingston.

Mr. George W. Brittnell has been appointed sales representative for Eastern Ontario of the Palmer Lime and Cement Company, 103 Park Avenue, New York City. The company handles hydrated lime, and amongst the trade Mr. Brittnell is well known throughout Ontario. The Eastern office is with the Builders' Exchange, Goodyear Building, Toronto.

Mr. George Janin, Chief Engineer to the Montreal Council, has received an increase of $2,000 to his salary, making it $9,000 per annum. A few weeks ago Mr. Janin declined an increase of $1,000 on the ground that it was inadequate. Mr. Janin will now be in direct charge of the waterworks improvements. His health is by no means good, and it is probable that he will retire in a few months, but he is desirous of seeing the waterworks extension carried out before he resigns.



Mr. Archibald Currie, City Engineer of Ottawa and formerly of Westmount, who is resigning the Engineership of the Federal Capital.

MAINLY CONSTRUCTIONAL

EAST and WEST — FROM COAST to COAST

EASTERN CANADA

The Chatham City Council is considering the question of appointing a building and plumbing inspector and the drafting of a by-law to define his duties.

The Shamrock Amateur Athletic Association, at Montreal, contemplate the erection of a grand stand at an estimated cost of $200,000, and will appoint an architect shortly.

Messrs. Foley & Gleeson, Ottawa, were the successful contractors for paving work at Kingston, Ont., estimated to cost $125,000. The contract comprises 50,000 square yards of sheet asphalt on concrete base.

Tenders will be called in September for a grandstand to be erected at Quebec City at a cost of $100,000. The construction will be fireproof, of reinforced concrete and steel. The architect is Mr. J. H. Pinsonnault.

Operations are now in progress on the new building which is being erected at Notre Dame de Grace, Montreal, for Loyola College, according to plans prepared by Messrs. Peden & McLaren, architects. The general contractors are Messrs. Anglins, Limited, Montreal.

The Montreal Board of Control have appointed Mr. Eugene Payette architect for a civic library on Sherbrooke Street East. The cost will be $200,000. It was originally intended to have received competitive plans, but the idea of a competition has been abandoned.

The Dominion Savings Company are to erect an office building at London, Ont., at a cost of $200,000, and the razing of the old structure has been completed. The new building will be four storeys high, of steel and brick construction. Mr. W. G. Murray is the architect.

The contractors have completed the excavation for the Assembly Hall which is to be erected at Montreal for St. Patrick's Parish at a cost of $135,000. The new building is to be of stone, steel and reinforced concrete construction. The architect is Mr. J. P. Hynes and the general contractors are Messrs. John Quinlan & Company, Montreal.

Foundation work has been completed on the new church which is being erected at Montreal for St. Michael's parish. The architects are Messrs. Beaugrand-Champagne & Chenevert and the general contractors the Atlas Construction Company, Limited, both of Montreal. The building will be of stone, brick and terra cotta construction.

Work on the new waterworks pumping station at Sarnia, Ont., is progressing rapidly, the contractors, Messrs. Guttridge & Grace, having completed the construction of twenty-one of the twenty-four infiltration basins. The building itself has been completed and the pumping engines and boilers are being installed. The entire cost of the scheme is estimated to approximate $250,000.

Work on the construction of the new government breakwater at Kincardine, Ont., has advanced so rapidly that it is anticipated the six hundred feet under contract will be completed this fall. The lake bottom is said to be of very hard clay, with boulders that make difficult the work of preparing a suitable foundation. Dredging the bottom for the laying of the cribs has commenced and five strongly-built wooden cribs are at present in the harbor ready to be towed out and sunk, after which they will be filled with stone until three feet from the lake level, when cement concrete will be used to build the upper structure.

Although the construction of the dry dock at St. Joseph de Levis, Que., was commenced as recently as May last, rapid progress is being made by the contractors, the M. P. & J. T. Davis Company, who have more than two hundred workmen employed at the site. The dock will be 1,150 ft. long, 120 ft. wide and about 70 ft. deep. The structure will be of concrete and granite. The dry dock will be able to accommodate the largest ships afloat.

Of the many evidences of building development in Toronto not the least conspicuous is the approval on the part of the City Council of a scheme for the re-organization of the City Architect's Department. Besides a request for increased and better equipment for the architect's offices, the plan calls for the appointment of six additional building inspectors, three plan examiners, two clerks and a stenographer.

The Canadian Vickers Company, Montreal, will commence in August the construction of what promises to be the second largest ice breaker in the world. The vessel, which will be constructed at the Maisonneuve plant at a cost of one million dollars, is to be used by the Canadian government for ice breaking in the River and Gulf of St. Lawrence. It will be of the heaviest type of construction and the following dimensions: length 292 ft., width 66 ft., draft 19 ft. The equipment will include 8,000 h.p. engines. It is to be ready for launching next May. Close on 900,000 feet of Southern pitch pine is on the way to Montreal from Georgia for the purpose of erecting the launching ways.

The municipalities in the Welland Canal zone have failed to agree regarding the basis of apportioning the cost of the pipe line from Port Colborne to the reservoir at St. Catharines. The Hon. Frank Cochrane, Minister of Railways and Canals, conferred recently with representatives from St. Catharines, Welland, Thorold and Merritton, apparently without success. The total cost is estimated to exceed one million dollars, of which the government will contribute more than one-half. Mr. Cochrane proposes the distribution of the cost as follows: St. Catharines, $275,000; Welland, $95,000; Thorold, $90,000; Merritton, $35,000. It seems doubtful whether this contributory scheme will meet with the approval of the various interests concerned.

The Quebec Board of Health sanitary survey of the Richelieu River from Sorel to Rouse's Point has been completed under the direction of Mr. Theo. L. Lafreniere, sanitary engineer, with Doctors A. Corsin, R. Gautheir, and H. Sanson, district medical inspectors. Thirty-four sampling stations were established. Less contamination in the river was found above St. Johns, P.Q., owing to the smaller number of inhabitants, but from St. Johns to Sorel a steady increase of contamination was found in the river, from which the villages and municipalities take their water. All the Richelieu River water supply should be thoroughly purified, says Mr. Lafreniere, who will suggest in his report as the most economical method that filtration plants of the gravity type be installed, and that the water be further purified by hypo-chloride.

The course in Architecture leading to the degree of Bachelor of Architecture at McGill University has been increased from four to five years. The change has just been announced by the University Corporation in the Calendar and is made because a thorough education is aimed at. Hitherto, the course has been sufficient to give a student a thorough education in Architecture, but to include all subjects it meant a great deal of work. In treating of the change in the course, the Calendar says: "The object of the curriculum in the first year is to impart such general culture, scientific knowledge and skill of hand, as will prepare the student to profit by the work of the succeeding years. An arrangement has been concluded between McGill University and the Province of Quebec Association of Architects whereby holders of the Bachelor of Architecture degree are admitted to practice in the province, after spending one year in the office of a member of the Association, and passing an examination in Design, instead of having to take the regular prescribed entrance examinations. The office experience may be gained by working in the summer vacations."

St. John, N.B., Development

The plant of the St. John Milling Company at West St. John, which was destroyed by fire recently, involving a loss of $20,000, will be rebuilt at once. This was one of the most successful milling plants in the province.

A great scheme of development and reclamation is in progress on the western side of St. John harbor, the purpose being to provide berths the coming winter for some of the larger ocean steamships of the Canadian Pacific Railway and other lines. Four hundred men, five tugboats, three dredges, two locomotives and trams and four reclamation plants are engaged in this stupendous undertaking. The contractors are the Maritime Dredging and Construction Company, who have sublet to Cape & Company and D. C. Clark. Unless something unforseen arises, the contracts will be completed in time.

Two schemes for the erection of large hotels are in progress at St. John. One provides for a nine-storey hotel on Germain street, occupying the space between Princess and Horsfield streets. It will be called the Hotel Carleton, and will be fashioned after the style of the new Vanderbilt Hotel, New York. Hon. William Pugsley, of St. John, and Mr. Thos. W. Lawson, the well-known Boston financial man, are among the promoters of this enterprise. The second hotel scheme is of even greater magnitude. It covers the erection of a mammoth hotel on the north side of King square, one of the finest sites in the whole city. Mr. C. H. Cahan, of Montreal, is among those interested in the construction of this hotel.

In pushing forward the harbor and industrial development at East St. John, N.B., three hundred workmen, one powerful suction dredge, three high-power elevator dredges, an ocean tug, five locomotives and ballast trains, two steam shovels and other accessories, are constantly employed by the Norton-Griffiths Company. The firm have almost completed an immense breakwater of stone. They have reclaimed over twelve acres of land for a ship repair plant, have excavated about one-third of the site for a dry dock, and have made considerable progress in dredging berths inside the breakwater for ocean commerce and in widening and deepening the entrance channel. Next spring they expect to begin the construction of concrete and steel cylinder quays for ocean berths, and a pier at the entrance to the dry dock. Their contract, which expires in 1917, covers the supplying of twenty-three steamship berths and involves an expenditure of over thirty million dollars. It is expected that this particular point will be utilized by the Grand Trunk Pacific Railway.

WESTERN CANADA

The government appropriation for dry docks and harbor improvements at Victoria, Vancouver, and Prince Rupert amount to about $15,000,000.

The Pacific Lock-Joint Pipe Company are proceeding rapidly with the construction of a 28-mile conduit, 42 ins. in diameter. The pipe line, which will be reinforced concrete, is in connection with the Victoria, B.C., water supply.

The erection of the new residence at Regina for the Lieutenant-Governor of Saskatchewan will not be started until next spring. Plans have been prepared by Messrs. E. & W. S. Maxwell, Montreal. The building is estimated to cost $150,000.

The first shipment of Western Canada reinforcing bars ever made by water by the Dominion Iron & Steel Company is at present on its way from Sydney to Victoria, B.C. The cargo consists of 5,000 tons of rails for the C. N. R. and 1,000 tons of concrete reinforcing bars for the Victoria piers.

The Winnipeg and St. Boniface Harbor Commission learns that the Canadian Parliament has passed an appropriation of $200,000 for harbor improvements on the Red River at Winnipeg and St. Boniface. Work on the docks will be proceeded with as soon as possible, and the commissioners believe that dockage facilities sufficient to handle the traffic will be ready before the close of navigation.

Plans for a Dominion government drill hall, which is to be erected at Vancouver at an estimated cost of $350,000, have been prepared by Messrs. Perry & Fowler, of Vancouver. The dimensions of the building are 278 ft. by 174 ft. The drill hall proper measures 225 ft. by 120 ft., extending to the roof of the building with a sweeping arch above. The company armouries and officers' rooms will surround the building and a swimming pool, gymnasium, miniature rifle range, bowling alleys, etc., will be provided in the basement.

Damage estimated at between four and five thousand dollars was done to the Pipe Fabricating plant operated by the Burrard Engineering Company, at Thetis Cove, Esquimalt Harbor, on July 8, by a fire which resulted from the ignition of inflammable material in the dipping tank. The plant was leased by the Burrard Engineering Company and was formerly owned by the Westholme Lumber Company, original contractors on the Sooke Lake work. It is announced by Mr. Bird, president of the company, that pipe fabrication is proceeding and that the only delay occasioned is in connection with repairs to the dipping tank.

A distinct sign of the times in regard to railroad and bridge development in Western Canada, is the announcement that the Saskatchewan Bridge & Iron Company, of Moose Jaw, are erecting an addition to their plant in the west end of the city, which will be 120 ft. by 75 ft. and will be used as a foundry, machine shop and pattern room. It will be of steel and brick construction. Work is proceeding on the foundations and the superstructure will be erected without delay. This company have already extended their operations into Alberta, and the steel frame of a new factory at Medicine Hat has been constructed.

The residents at Swift Current, Sask., are apparently convinced of the soundness of the town planning idea. A public meeting was held on July 15, at which addresses were delivered by Mr. Malcolm Ross, Provincial Government Landscape Artist, and Mr. Mawson, of T. H. Mawson & Sons, town planning experts. The matter is not to be allowed to rest as the City Council has been requested to engage the services of a qualified town planner to prepare a comprehensive plan for the location and development of public buildings, parks and playgrounds, the solution of railway grade, station and subway problems, sewers, lay-out of streets and all public works. The matter has been taken up with enthusiasm by the people of Swift Current, who are desirous of coming into line with the other cities and towns in the Dominion in the matter of city planning.

Harbor improvement work at Victoria, B.C., has been the most extensive in any city on the coast within recent years. The inner harbor has been made the most of, but its size limits its use particularly to the coastwise and ferry-boats. For accommodation of deep-sea vessels, whose business at Victoria is steadily increasing, the problem was the development of the outer harbor, a semi-circular arm of the sea leading in from the Strait of San Juan. This necessitates construction of a breakwater at the entrance, part of which will form one of the Dominion government piers. This breakwater is to be 2,550 feet long. The government work will consist of four piers inside the breakwater and contracts for the construction of two of these piers known as piers 2 and 3 have been let. These piers will be about 1,000 feet long and 250 feet in width and construction will be of concrete. The depth of water alongside will be between 50 and 60 feet. Excavation work has been going on for some time. The initial expenditure upon this project by the government is $2,500,000.

A reinforced concrete sewer, which will drain a section of the city 425 acres in extent, also 800 acres in Saanich and 1,000 acres in Esquimalt, is under construction at Victoria, B.C. The sewer will be two miles long when completed and will discharge into an outfall near Macaulay Point, where it will empty through several hundred feet of steel pipe at a point below water level where the tides admit a favorable disposal. The trunk sewer is 27 ins. in diameter at its beginning, increasing to 36 ins. at the outfall. The sections of reinforced concrete pipe are cast in five-foot lengths. The excavation for the sewer consists of about 7,250 ft. of rock tunnel and 3,100 ft. of open work. The tunnel work maintains a depth of 65 ft. below the surface and consists essentially of three separate tunnels, the first of which is now being driven, and in connection with which two shafts have been sunk. The tunnel will be five feet in width and seven feet in height. The excavation material is mainly solid rock and admits of an average daily progress of five feet. Mr. A. E. Forman, assistant to Mr. C. H. Rust, City Engineer of Victoria, has charge of the work.

Canadian Railroad Development

Construction work on the Kamloops-Okanagan Branch of the Canadian Northern Railway is expected to commence shortly. Mr. S. H. Sykes, assistant-chief engineer of the company, visited Vernon, B.C., recently, for the purpose of conferring with a special committee of the City Council with reference to crossings, bridges and the route of the projected line through the city park.

Hearst, a divisional point on the National Transcontinental Railway, some distance west of Cochrane, Ont., was wiped out by fire on July 16. The town contained some six or eight hundred inhabitants, and most of the dwellings were of wood construction. There were the divisional offices of the Transcontinental Railway, a large cement roundhouse, and the offices of Messrs. O'Brien, McDougall & O'Gorman, railroad contractors, who had their headquarters at Hearst.

The grading of the Patricia Bay branch of the Canadian Northern Pacific Railroad, and also of the main Vancouver Island line, has advanced to such a stage that preliminary arrangements are being made for the laying of steel. Tenders will be invited immediately for the construction of a temporary wharf, 40 ft. in length by 64 ft. in width, at Patricia Bay, capable of accommodating at low water a vessel drawing 24 ft. Steel for the contract will be obtained from the Dominion Steel & Iron Company.

Steel laying on the new Weyburn-Lethbridge branch of the C. P. R. is now extended to the Alberta boundary line, the work having been advancing steadily during the summer at the rate of about three miles a day. When completed the line will be about 410 miles long. In addition to the construction work on the Weyburn-Lethbridge line the C. P. R. is also double-tracking the main line between Regina and Broadview, and two gangs of men are working, one between Regina and Indian Head, and the other near Grenfell. Operations are expected to be completed in September, by which time the company will have a double-tracked line practically all the way across Saskatchewan.

An ambitious scheme for handling the railway traffic at Montreal has been planned by one of that city's Controllers, Mr. Herbert. The scheme briefly consists of the construction of a Union Station to receive the traffic of the C. P. R., the C. N. R., the G. T. R., and other lines with running rights; the construction of an overhead line along Common street to receive the traffic from the old Victoria bridge; the construction of a subway between the proposed Union Station at Mile-End and the removal of the C. P. R. tracks along the water front; the construction of a subway to connect with the C. N. R. tracks and the removal of Moreau street station, and the purchase of Bonaventure station and the right-of-way to St. Henry, with the removal of the present tracks. It is proposed that the enterprise, which has not yet been submitted to the City Council, shall be municipal and administered by a special commission.

Edmonton Notes

Permits for buildings valued at $740,750 were issued in Edmonton in June, bringing the total to $3,562,847 for the first six months of 1914.

Mr. George O. Sanburn, of Seattle, has come to Edmonton to establish a sweater factory and will erect a plant, which is to be in operation next fall.

Messrs. Brown & Hargraves, builders, and Ross Brothers, Limited, plumbers, have received contracts, involving $78,228, to erect an eight-room addition to Rutherford School in Edmonton.

Good progress is being made on the ten-storey business block which is being erected at Edmonton for Mr. K. McLeod of that city. The estimated cost is $450,000. Messrs. Olson & Johnson, of Edmonton, are the general contractors.

Two and a half million dollars will be expended by the municipality of Edmonton in completing its improvement programme for 1914. To provide the funds, the city council has adopted the report of Mayor McNamara, finance commissioner, to issue $4,500,000 worth of 4½ per cent. treasury notes. The necessary by-law has been passed by the council.

Mr. W. R. Smith, chief engineer of the Alberta and Great Waterways Railroad, 280 miles long, now under construction between Edmonton and Fort McMurray, announced in Edmonton that 1,100 men are at work on the grade, which should reach Lac la Biche in October. Fourteen miles of grade is completed. The road is being built under the direction of the Government of Alberta.

Seventy-five thousand dollars is the estimated cost of the Exchange building that is being erected for Mr. John Kelly at Rice Street and Howard Avenue, Edmonton, by the Zenith Construction Company, from plans prepared by Van Sicklen and MacComber, architects. The structure will be four storeys high and contain six stores and sixty office rooms and 6 11-foot basements. Reinforced concrete and brick will be used.

Mr. W. D. Van Sicklen, architect, has completed plans for a seven-storey office building to be erected in Jasper Avenue, Edmonton, for Hon. Wilfred Gariepy, minister of municipal affairs for Alberta, at a cost of $200,000. It will be of reinforced concrete, with a frontage of 80 feet in Jasper Avenue and a depth of 90 feet. The exterior will be red brick and terra-cotta, and the interior will embody the latest ideas in office accommodation. Work will begin in August.

The Deputy Minister of Public Works for Alberta says, in his annual report, which is to be issued in a few weeks, that 316 wooden bridges and 16 steel spans were constructed by the department in Alberta during 1913, also that 98 bridges were repaired. Eleven ferries were built and installed and six ferry scows were replaced with new craft. Sixty ferries are now in operation. A large amount of trunk road work was completed. Aside from this, the department reports the completion of the parliament buildings in Edmonton, the erection of the government house in Edmonton, the land titles building in Edmonton and agricultural schools at Olds, Claresholm and Vermillion. The work in the surveys branch showed an increase over previous years.

Firing tests of native shale, now being made in Canada and the United States, will determine whether the city of Edmonton will add a $1,000,000 plant, financed by British capital, to the local industries. The firm is represented in Canada by Montreal capitalists. Tile and brick will be the chief products of the establishment. The Edmonton Industrial Association and Mr. George M. Hall, industrial commissioner for Edmonton, are working on the proposition. All that remains is to prove the commercial value of the shale by expert firing. Tests have been made in this direction and the results are reported to be highly satisfactory. The shale is grey and has passed through the oxodization state. The deposit, said to contain millions of tons, is within eight miles of the city.

The Cement-Gun is described in detail in an interesting book compiled and edited by Arthur E. Lee, General Manager of the Cement-Gun Company, Inc., New York. The object of this book is to give a fairly comprehensive idea and description of the Cement-Gun apparatus, the prices, the product, and the various applications to engineering and constructional operations. The book is profusely illustrated with excellent half-tones.

Fittings, Limited, of Oshawa, Ont., are well-known manufacturers of Diamond Brand pipe fittings, malleable and cast iron fittings, including cast iron recessed drainage fittings. The fine grey iron castings manufactured by this firm are favorably known to the trade, as also are the sash weights and cast washers, of standard size, and detachable chain link belting. The company, whose headquarters are at Oshawa, also carry on operations at Montreal, Winnipeg, and Vancouver, so that their products are familiar to the building trade all over the Dominion.

The Ebsary Fireproofing Company, Toronto, have carried out a number of extensive contracts for gypsum fireproofing recently. One of the most important of these has been the fireproofing work in connection with the new Royal Bank building in course of erection on the north-east corner of Yonge and King Streets, Toronto. About 400,000 square feet of the material was put in, and the fact that it was handled in something like forty-five working days reflects creditably upon the enterprise of this firm. Another recent contract put through by the company was in connection with the new Orphanage at Oakville, Ont., for the Independent Order of Foresters. In this building gypsum fireproofing, which was manufactured in Caledonia, Ont., is used in the partition walls throughout the building. Not only is it absolutely fireproof, but it is claimed to be one of the greatest non-conductors of sound. Conspicuous among the buildings for which the Ebsary Fireproofing Company have supplied gypsum fireproofing may be mentioned the following: The Fort Garry Hotel, Winnipeg; the MacDonald Hotel, Edmonton; and the Ritz-Carlton Hotel, Montreal. The manager of the company is Mr. F. S. Bridges.

A number of good contracts for flooring material have been obtained by Messrs. Canada Floors, Limited, according to information to hand from Mr. F. Shaw, the firm's manager at Montreal. The list of new buildings includes the following:—St. John the Evangelist's School, Pointe St. Charles; Notre Dame School, Three Rivers; Kensington School, Notre Dame de Grace, and the William Trenholme School at Rockfield, P.Q., also new Catholic schools at Montreal, Longue Pointe, and Notre Dame de Grace. The various lines manufactured by Canada Floors, Limited, comprise Canada Mosaic Floors, Magna-Asbestos Floor, Canada Mastic Floors, Asphalt Waterproofing and Asphalt Roofing.

Awards have been made in the competition announced several months ago by the Barber Asphalt Paving Company, for papers from engineering students on the subject of Asphaltic Materials for Highway Construction. The judges of the competition, Mr. E. J. Mehren, Editor Engineering Record, and Mr. H. P. Gillette, Editor Engineering and Contracting, have made awards of prizes of $100 each to the following contestants: Frederic O. X. McLoughlin, Columbia University; Harry Schindler, Cornell University; B. J. Fletcher, University of Georgia; John W. Hill, University of Illinois; Robert S. Johnson, Iowa State College; M. V. Holmes, University of Kansas; F. P. Gilbert, Massachusetts "Tech."; Harold J. LaLonde, University of Michigan; Benjamin Wilk, University of Minnesota; Alvin C. Smith, University of Nebraska; O. H. Gosswein, Purdue University; Alfred A. Berkowitz, Scheffield Scientific School; W. J. Campbell, Syracuse University. The purpose of the competition was to turn the attention of engineering students to street and road construction as a promising field of work. The company offering the prizes believes that the plan was successful in this direction.

New Exhaust Steam Heating Encyclopedia

The Harrison Safety Boiler Works have recently put forth for distribution their new 207-page edition of the Exhaust Steam Heating Encyclopedia, which should prove a valuable addition to the library of any engineer. It contains much information on the use of exhaust steam for heating, the result of many years of careful study. It illustrates and describes some twenty-eight different commercial systems of exhaust steam heating, showing at the same time the application of the new Cochrane steam stack and cut-out valve heater thereto. It is claimed on behalf of the Cochrane heater that it contains the latest improvements in the design and construction of the open type feed water heater, especially where used in conjunction with steam systems. In this connection the application of the enlarged oil separator and cut-out valve simplifies the piping arrangement, thereby reducing the cost of installation. The special application of the Cochrane steam heater to condensing plants and low pressure steam turbines and ice and refrigerating plants; the "V" notch weir for the measurement of hot boiler feed water; and the Cochrane multiport safety exhaust outlet valve for the control of the pressure and exhaust steam heating and drying systems, are fully described.

Tables and information relating to exhaust steam heating, data on temperatures and heat losses, tables on the properties of air and steam, heat transmission for low pressure steam, together with data for hot water heating with forced circulation, are also contained in this edition.

The Canadian Allis-Chalmers, Limited, as the sole agents for Cochrane apparatus, will supply copies of this catalogue to engineers on application.

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Alphabetical Index of Advertisers
Page 18

Vol. 28 **August 5, 1914** **No. 31**

Principal Contents

Preference—A Misnomer 977

Construction and Production in Saskatchewan 978

The Various Types of Movable Bridges 979-89
By W. M. Wilson

Ultimate Strength of Carbon-Steel Models of Quebec Bridge Members 989-91

Bacillus Coli in Water Supply—Its Significance and Importance 991-2
By Jos. Race

Advantages of Method in Construction Work 993-5

Method of Finishing Concrete Alley Pavements 996-7

Costs and Other Features of Surfacing Track 998-1000

Dual System of Water Supply and Distribution ... 1000-1

Garbage Collection and Disposal at Vancouver 1002

Biographical—Mr. S. M. Brookfield, Halifax, N.S. ... 1002

Personal Mention, Constructional and Industrial News 1003-6

Preference—A Misnomer

WHAT'S the matter with Vancouver's civic administration? In the light of recent developments one is justified in putting the query. Last week we discussed the unsavory conduct of a competition arranged by the local authorities; this week we desire to call attention to a matter of policy which has a far wider aspect.

In British Columbia there has been started a movement which has for its goal the encouragement and support of local industries by giving them a preference in trade, especially in the matter of material for public works and municipal supplies. Superficially and sentimentally such a policy might appear to be a good one, but when open competition is advertised it is impracticable in effect—that is to say it is impracticable if the competition is to be conducted on sound business principles. We are reminded of the matter very forcibly by an account of a recent meeting of the Vancouver City Council, when by the deciding vote of the Mayor the contract for a supply of valves for the waterworks department was awarded to a local firm, notwithstanding the fact that their bid was 22 per cent. higher than that of a United States competitor. To the credit of a faction in the council be it said that there was strong opposition to the award of the contract to a higher tenderer, the vote resulting in a tie which was decided by the Mayor. As far as our sympathies go, and as far as our patriotism is concerned, we believe that we could out-Vancouver any municipal council in British Columbia, but in a matter of this kind where reputation is at stake, and where honesty of business principle is concerned, preference, patriotism, sentiment, and so on are cheap substitutes for a glaring injustice. If the city of Vancouver or any other local body believe it to be in their best interests to confine competition to a coterie of their local supporters let them do it—but not under the guise of open competition. To go through the farce of calling for tenders and award a contract at a figure 22 per cent. higher than the lowest bid is an abomination of municipal practice which cannot be defended on the ground of "B. C. for British Columbians," "Canada for Canadians" or any other such delusive patriotism.

Canada is a young country, but she has already been imposed upon to the limit in the matter of local sentiment. Too often there have been ulterior motives behind the apparently patriotic actions of councils and other bodies in passing over outsiders. Brown has an interest in a brick plant, Jones' son is identified with an iron works, Smith has a remote connection with some other line of supplies, and so throughout the greater part of the council there is a laudable desire to promote home industries. Protection of home industries! What about the home industry of the ratepayer who has to foot the bill at 22 per cent. higher? He has a home industry whose interests are betrayed by such procedure.

On more than one occasion we have advocated the desirability of enabling the governing authority to use its discretion in the matter of the lowest bid, but we have had in mind only constructional work, where a man of insufficient financial backing or inadequate experience might be entrusted with a responsible public enterprise the failure of which would bring about great inconvenience and delay. That sort of thing is a far cry from a contract for a supply of valves, the requirements of which could be specified to a hair. When tendering on a building or some municipal undertaking, such as a waterworks or sewerage system, there are a dozen ways of omission and commission in which a contractor can make a bad blunder. Having discovered this a corporation might be well advised to pass over the bid, using its discretion in the matter of the deposit cheque. That is a different story.

It is not the first time we have had to direct attention to the evils of local preference. If preference of any kind is to be shown surely it should be set forth in the invitation to tender. Is it conceivable that any contractor would take the trouble to make up a tender if he knew that he was under a handicap of twenty or twenty-five per cent.? Then why rob him of the time and labor involved in preparing his bid? The policy of local or provincial preference as the Vancouver City Council understand it is a dishonest subterfuge for getting something for nothing and sooner or later it must re-act with dire results. **Under one condition only can preference be shown local industries and that is where all other things are equal**—which seldom happens.

We are told that there is a general campaign under way in Vancouver, and in the province generally, to create a sentiment in favor of purchasing British Columbia-made goods—even at a higher price than the imported article. In connection with the Second Narrows Bridge across Burrard Inlet, which is to cost approximately $2,000,000, it has been suggested that the specification of British Columbia manufactured steel and iron shall be compulsory. Further, the British Columbia Manufacturers' Association have adopted a label to be stamped on all goods manufactured in British Columbia—"in order," we are told somewhat facetiously, "to educate the public to ask for articles made in the province in preference to goods made in Eastern Canada or in foreign countries." In Eastern Canada or in foreign countries! When one thinks of the extent to which Vancouver and British Columbia—and in fact all Western Canada—have been dependent upon "foreign countries" (we include Eastern Canada) it makes one weep at the folly of the Coast Province.

Upon the wider question of the effect of such things upon the reputation and trade of the country at large we could say much, but we will not digress further. The corporation of Vancouver and the Provincial Government of British Columbia should come into the limelight with their policy. There are plenty of us in Eastern Canada and "other" foreign countries who desire to see Canadian industries flourishing, but it must not be, and it shall not be, at the expense of our national business reputation in Great Britain and the United States. Our best interests are bound up in the good-will of these countries—indeed, without British support our comparatively autonomous state could never have existed. Vancouver is not—fortunately—the hub of Canada, and British Columbia is not the whole of Canada.

During the last decade Canada has made many proud boasts—boasts capable of fulfilment only by strenuous devotion to honest enterprise. From one end of Canada to the other we want the enterprise that is engendered by competition. If we are to develop on bigger, broader and better lines we must have it. If we are to become self-centred in a state of mediocrity far removed from that destiny which many of us have pictured so fondly, we can dispense with it.

We would respectfully commend to the serious consideration of that enlightened city of British Columbia the well-worn but apparently ill-learned maxim, "Competition is the life of trade."

Construction and Production in Saskatchewan

Some interesting information regarding trade and constructional development in the Province of Saskatchewan is contained in the third Annual Report of the Bureau of Labor for 1913. While building permits for the cities of the province show a falling off in value from $23,564,561 in 1912 to $16,022,455 in 1913, yet the value of last year's buildings exceeds those of 1911 by nearly three million dollars. The report, dealing with Saskatchewan industries, states that despite the much-talked-of financial stringency during 1913 all the principal industries of the province show an increase in volume of business over 1912. Statistics regarding the manufacture of brick and tile show that the amount of capital, including plant, involved in the manufacture of brick in 1913 totalled $1,046,088, as against $314,796 in 1911. The plants in operation last year numbered eighteen, an increase of five on the two previous years, whilst the gross value of the product in 1913 is given as $594,630, compared with $187,824 in 1911. These returns from brick manufactures would tend to indicate the use of an increasing number of bricks of local or home manufacture for building operations from year to year

The report records the information that during 1912 Saskatchewan was the only province of the Dominion which showed an increase in the production of lumber over the cut of 1911, and that this increase was not less than 16.7 per cent. of the figures for the past three years. The value of lumber cut in 1911 was $2,266,435, being an increase of 77.5 per cent. and an average value per thousand feet, B.M., of $16.82. Lumber cut in 1912 represented in value $2,535,611, an increase of 16.7 per cent. and an average value of $16.12. The return for 1913, however, shows a falling off in the value of lumber cut to $1,908,482, or a decrease of 27 per cent. and an average value per thousand feet, B.M., of $16.62.

Regarding building operations the report has the following to say: "Whilst the total value of buildings erected in the cities of Moose Jaw, Regina, Saskatoon and Prince Albert is considerably less than in 1912, nevertheless it exceeds that of 1911 by nearly three million dollars. During the year 1913 two towns were added to the number of cities of the province with the result that the total value of buildings erected in the cities during 1913 was $17,159,950. To this might be added the building permits of Swift Current, which no doubt will incorporate as a city during the coming year, and it will then make a total value of buildings of $18,169,008."

Standard building-construction specifications issued by the National Fire Protection Association, Boston, are intended to establish requirements of construction suited to buildings of the greatest fire resistance. The principal items are incombustible material for all structural parts, ample space exits for all occupants, protection against exterior fires, provisions for confining interior fires to space in which it originates and installation of apparatus for extinguishing fire in its incipiency. Detailed specifications are given for service equipment, height, area, location and character of exits, allowable stresses, character of material and dimensions, construction and strength of walls, piers, columns, roofs, floors, stairs, shafts, partitions and wall openings.

The Various Types of Movable Bridges

A Comparison of the Many Modifications of Swing, Bascule, Direct-Lift, Pontoon and Transporter Bridges and Their Bearing Upon Transportation: Features of Design and Adaptability to Varying Conditions.

By W. M. Wilson[*]

PART I.

WITH the rapid increase in transportation and the accompanying congestion of traffic and increase in transportation facilities, one of the problems which is forcing itself more and more upon the attention of the engineer is that of providing transportation over navigable streams without interfering with navigation. This transportation has been provided for by the use of ferries, high overhead bridges, tunnels beneath the channels, and by movable bridges which when closed provide the traffic over the streams, but which can be opened as occasion demands, so as to provide a clear channel for the passage of vessels. The ferry at best is a makeshift and can be used only where the land traffic is light or where a bridge would be impracticable. Tunnels are expensive to construct and necessitate the use of heavy grades which are very objectionable. High overhead bridges with underneath clearance sufficient for the passage of the largest vessels, are limited in use, to localities where the street or track level is very much higher than the water level. A large majority of the crossings are equipped with movable bridges.

In order to meet the widely varying conditions governing the design of movable bridges for the various crossings, the engineer has exercised considerable ingenuity and a correspondingly large number of types of movable bridges are in use to-day. Mr. J. S. Langthorn in a paper on Types of Movable Bridges presented before the Brooklyn Engineers Club, April 14, 1904, gave the following classification:

"1. Swing Bridges, which revolve in a horizontal plane.

"2. Side folding bridges, which fold up in a horizontal plane.

"3. Bascule bridges, which revolve in a vertical plane and include the following:

(a) Trunnion bridges, which are revolved on horizontal shafts.

(b) Scherzer bridges, which open by rolling backwards and upwards on segmental girders.

(c) Miscellaneous types as the Harway avenue, Page, Schinke, Roll, Jack-Knife, or vertical folding, etc.

"4. Retractile bridges, or sliding draws which open in a horizontal plane and are mounted on wheeled trucks. The telescopic bridge at Queen's Ferry, England, is a modification of this type.

"5. Direct-lift bridges, which are simply large elevators.

"6. Pontoon or floating bridges, in which the channel pontoons may be moved for passing vessels. In some cases the pivot end is placed on the shore.

"7. Transporter bridges, in which a car hung from a high level truss travels back and forth between the banks of the waterway."

While there are many modifications of these various types, the only distinctly different type from those given above that the writer has seen described is one which rotates about a horizontal longitudinal axis.

The earliest moving bridges of which we have any record were used for defensive rather than transportation purposes. These in general were bridges hinged at one end and lifted vertically by means of chains or cables fastened to the other end, or horizontal draw bridges in which the movable leaf was drawn back into the fixed approach span.

Of the early movable bridges used to provide for navigation the pontoon, or floating bridge, was very much in favor. These bridges were inexpensive and did not require for their construction the highly refined mechanical processes which are so essential to the successful manufacture of the newer types of movable bridges.

In the early days when land traffic was light and especially before the development of railroads which required that interruptions to traffic be reduced to a minimum, this type of bridge was very largely used. Its low initial cost and the ease with which it could be built without the use of elaborate equipment made it deservedly popular for pioneer road building in communities where funds were scarce and contractor's equipment crude. A comparatively large number of the early movable bridges built were of this type. A number of them are still in use. In addition to the advantages claimed above for this type of movable bridges is the advantage common to all pontoon bridges—since they require no foundations they can be built over streams whose beds are so soft that the support of a bridge on a pier is impossible. This has led to the use of pontoon bridges with pontoon draw spans over various rivers of India. Probably the most notable of these is the one over the Hoogly which connects Calcutta with Howrah. A number of bridges of the same type have been built at this crossing only to be replaced when worn out by similar bridges. The last one was built in 1874. Designs are being considered for a new bridge at this point.

As the density of traffic increased, and especially with the adoption of fast railway schedules, the delays incident to the more or less cumbersome operation of the pontoon bridges became more serious. The new conditions were well met by the use of swing bridges, and for some time—in fact, up to and including the present time—a very large proportion of all the movable bridges built were of this type. Bridges with pivots at or near the centre necessitating the use of but little, if any, counterweight and with supports to carry the live load at the centre and both ends are of economical design, of simple construction, quick of operation, rigid in service, and would seem to be of ideal design. The large number of these bridges in use indicates that they are so considered.

Horizontal rolling or retractile bridges were used in crossing moats around castles as a protective measure, but they have never been very popular among modern engineers. The rolling back and forth of the heavy structure consumes a large amount of energy.

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[*] Assistant Professor of Structural Engineering, University of Illinois.

It is difficult to provide a motion of the moving leaf which will enable it to clear the fixed approaches, and the live load must be carried on the moving leaf acting as a cantilever, which it is hard to do with a structure that can be moved horizontally. This type of bridge can be used for narrow channels and also for light temporary structures, but it has not been used much for large permanent bridges.

The last few years has brought about conditions which have made the swing bridge poorly adaptable to certain locations. Increase in water traffic, together with an increase in the size of boats, have made the centre pier, usually associated with swing bridges, very objectionable in narrow channels, and increased value of land and dock frontage has made them expensive because of the property which they damage. Because the width of the centre pier increases with the width of the bridge, it is not customary to have more than two tracks* on a single bridge, and as the bridges must be far enough apart to let the ends clear when the bridge is moving, the carrying of a large number of tracks over a channel at any point is impracticable, if not, in fact, impossible. These considerations have led to the development of the bascule bridge, which, while usually more expensive than the swing bridge, can be opened in a space no wider than its own width and which provides a clear channel with no obstruction at the centre. There are a number of types of bascule bridges all of which have a motion in the vertical plane which causes the centre of gravity of the moving parts to be stationary at the centre of rotation or to move in a horizontal line. If either one or the other of these two conditions is satisfied, the only work which it is necessary to do in moving the bridge is that required to overcome inertia, friction, and wind pressure.

While the earliest draw bridges built, those used to cross moats at the entrance to castles, were bascule bridges, they did not come into general use until the new London Bridge was completed in 1894. Since that time their use has become very common. It is interesting to note that while some of the modern types of bridges are generally supposed to be new inventions and some of them are patented, a number of them are described, at least in principle, in the Handbuch der Ingerieur-Wissensch, which was published in 1888.

Vertical lift bridges which are opened by lifting the moving leaf in a horizontal position so as to allow clearance for the passage of vessels underneath have been built from time to time during the last century. The very recent development of a number of new types of vertical lift bridges has led to their acceptance in a number of instances during the last one or two years. Their extended use in the future is quite probable.

As the width of channel required has increased, the weight of the moving leaf of the bascule bridge whose weight is carried as a cantilever has increased very rapidly, and the weight of the counterweight has increased a corresponding amount. This has caused a large increase in the trunnion loads and in the weight of structural steel required to support the moving leaf as well as in the counterweight which balances it. In the case of the vertical lift bridge, the effective arm of the counterweight is much greater than for the bascule, so that the counterweight is much lighter. The bridge is supported on four trunnions, instead of two, making a corresponding reduction in the load on each trunnion. The dead load as well as the live load is carried as a simple span, which is much more efficient than the cantilever of the bascule bridge. The live load is carried directly into the masonry and not through the trunnions. It is sometimes possible to convert a fixed span into a vertical lift span by adding the necessary lifting mechanism. These facts would seem to indicate that for long spans where the underneath clearance is not too great the vertical lift bridge has some advantages over the bascule bridge.

At some crossings the water traffic is very heavy and the land traffic is comparatively light. This combination of conditions occurring at a point where a

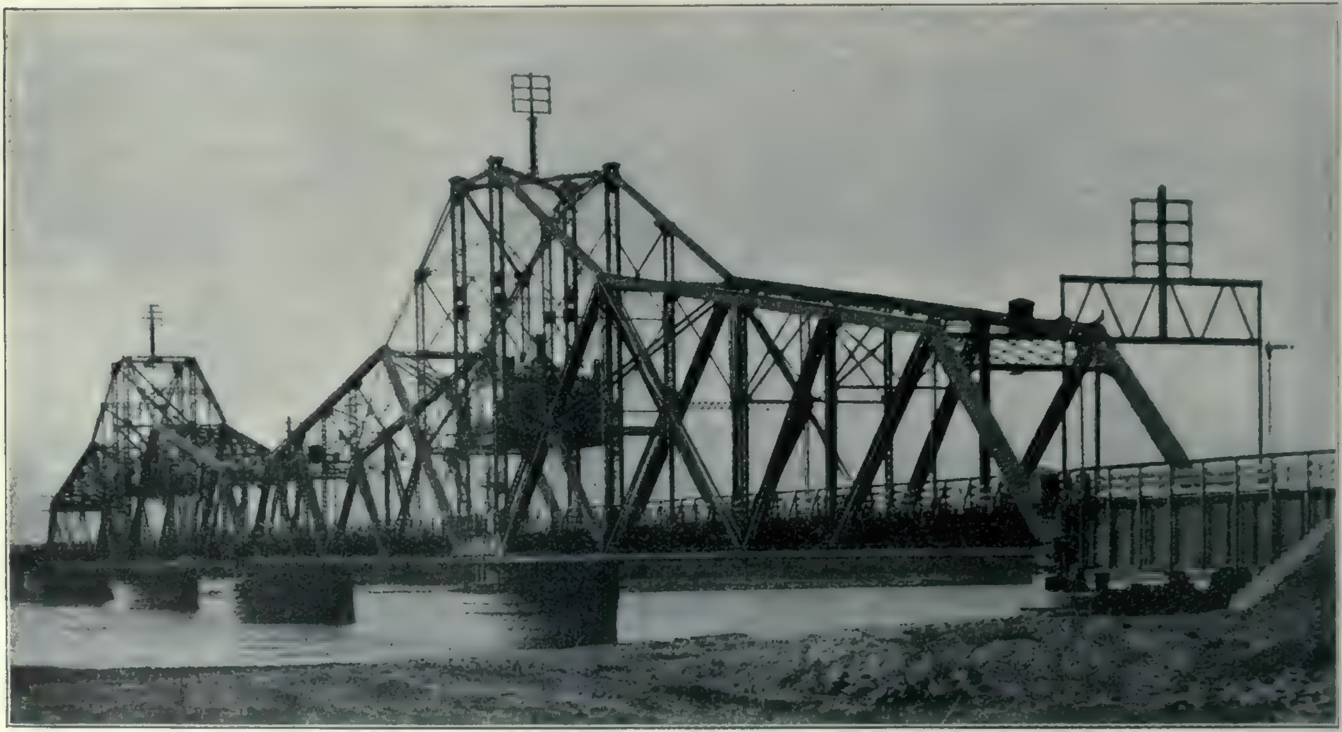


Fig. 1.—Two swing bridges over Missouri River at Omaha, Neb.

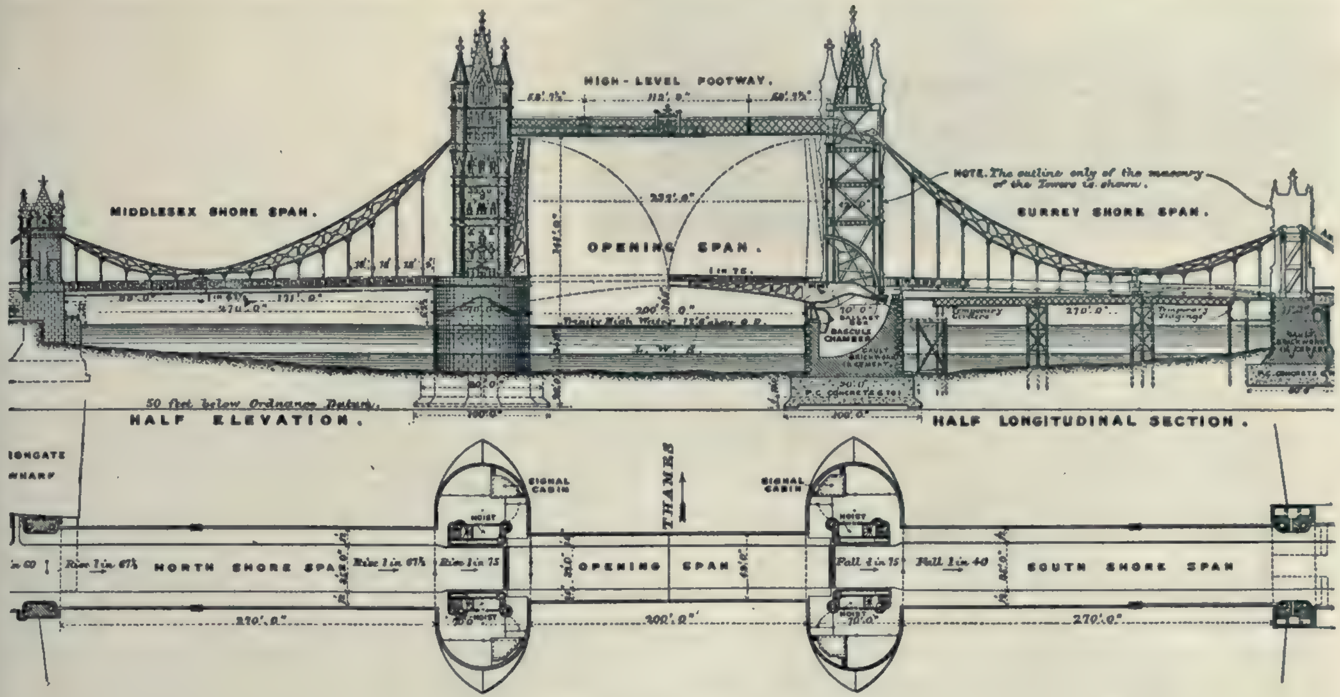


Fig. 2.–The Tower bridge, London.

The Various Types of Movable Bridges

Fig. 2 illustrates the general scheme of the bascule type. The draw span has a double-leaf bascule bridge supported on fixed trunnions and counter-balanced by counterweights. Each leaf is supported on four latticed girders. The distance, centre to centre of trunnions, is 206 ft. 6 in. Fig. 3 is the Scherzer rolling lift bridge, the first one of which was built in 1895. It consists of two leaves, each supported on two trusses.

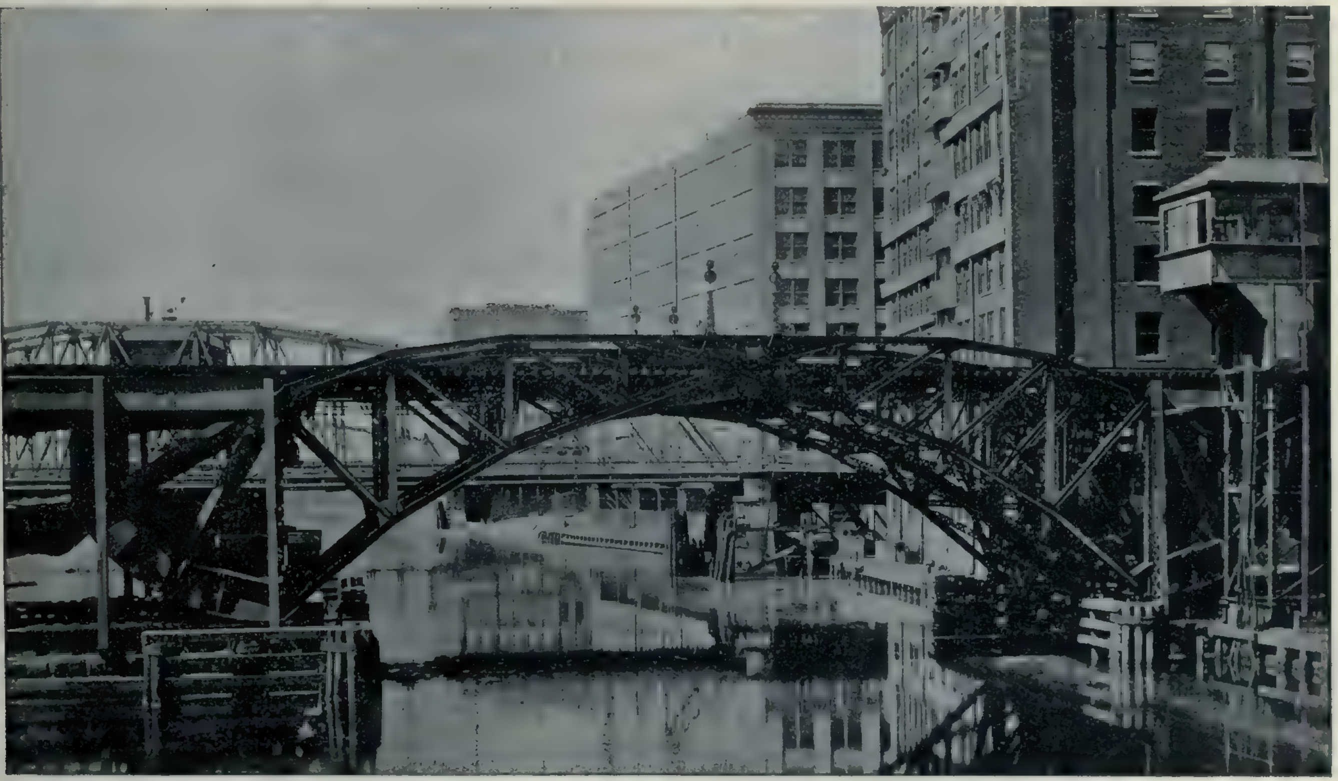


Fig. 3.–Metropolitan west side elevated railway crossing the south branch of the Chicago River.

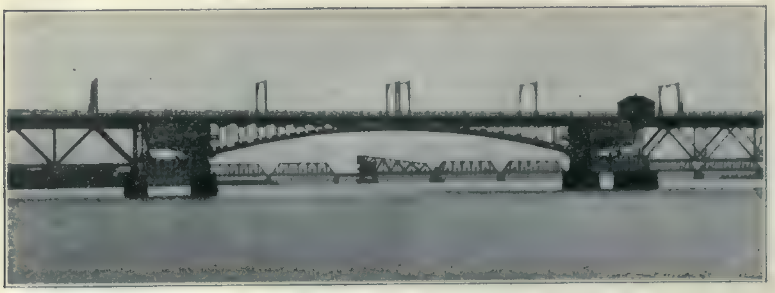


Fig. 4.—Rolling lift bridge over the Connecticut River at Saybrook, Conn.

bridge would be expensive to construct has led to the use of what have been termed transporters or transfer bridges. They are similar to ferries and usually consist of a car or platform either suspended from a high overhead track or supported on a track in the bed of the channel. This platform travels back and forth across the channel as is required to accommodate the traffic, and offers no serious obstruction to navigation at any time. While this type of bridge cannot be said to be in common use, a number of them are in service at the present time.

It is interesting to note in connection with a study of the various types of movable bridges in use that, with the possible exception of very special types which have proven unsatisfactory in service, all the various types of bridges which have been designed are represented by bridges in use to-day. This indicates that the development of movable bridges has not been so much an improvement on the old types as it has been a development of new types to meet new conditions. In localities where early conditions exist to-day old types of bridges are still being built.

Most of the early bridges were operated by hand. For the most part they were comparatively small, labor was cheap, and the modern efficient methods of developing mechanical power unknown. Even the large double leaf swing bridge over Penfeld River at Brest, which provided a clear channel of 350 ft., for half a century the widest clear channel provided by any movable bridge in the world, was originally designed to be operated by hand. Later hydraulic power came into quite general use in Europe and steam power in America. It is only within the last few years that electrical power has been used. At the present time electrical power is used almost exclusively for the operation of movable bridges. The ease with which it can be transmitted to any desired point and its property of being instantly available with no consumption of energy when no work is being done, makes it superior to other kinds of power for locations near a source of continuous supply. Most modern bridges are provided with an auxiliary driving mechanism which is usually operated either by hand or by oil engines.

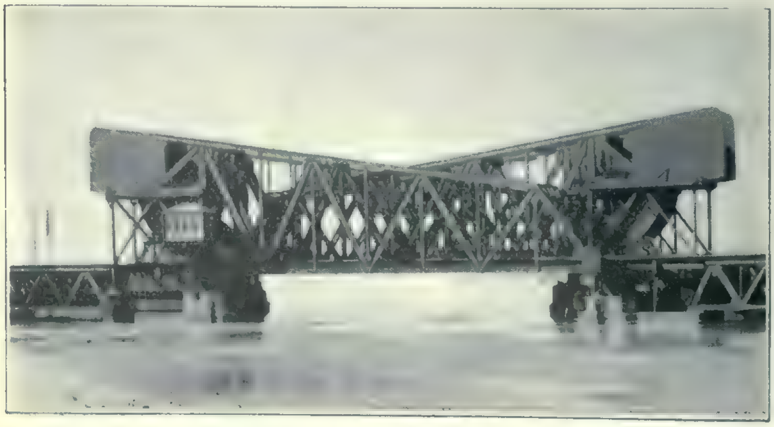


Fig. 4a.—Eight-track bridge, Chicago.

As stated above, many of the early moveable bridges were supported on pontoons and were opened by floating the draw span to one side. One of the more important bridges of this type still in use is the one which for a number of years has carried the C. M. & St. P. Railway over the Mississippi River, between Prairie du Chien, Wisconsin, and North McGregor, Iowa. The river at this point is about 7,000 ft. wide, including an island which divides the stream into two channels each of which is navigable, and the bridge, except for the draw spans, was originally a pile trestle. Each of these draw spans was carried on a single float, 41 ft. wide, 6 ft. deep, and 408 ft. long. The level of the track was adjusted to the varying stages of the river by blocking confined by a frame and adjusted by means of hydraulic jacks. The range of variation between high and low water was 22 ft. The elevations of the deck of the bridge was adjusted by the bridge tenders at times when they were not occupied in operating the bridge. Girders projected beyond the ends of the draw span and when the bridge was closed, rested on seats on piles provided to receive them. These girders prevented any live load coming on the floats near the ends and eliminated any harmful effects that might result from a slight difference in level between the fixed and floating decks. The bridge was operated by a 20 h.p. steam engine and could be opened or closed in about three minutes. The bridge was designed by John Lawler and was built in 1874. It was rebuilt in 1882; the Wisconsin end was again rebuilt in 1898 and the Iowa end in 1900. It still carries the traffic of the C. M. & St. P. Railway over the Mississippi River at this point.

A similar bridge was built over the outlet of Lake Champlain at Rouse Point in 1851. This bridge was 30 ft. wide and 303 ft. long, and was designed by Henry R. Campbell.

Swing bridges, which are the most familiar of all the various types of movable bridges, consist essentially of a truss or girder span which is balanced over a turntable on which it rotates about a vertical axis. The turntable consists of a pivot at the center of a circular track. The pivot serves to center the bridge and in some cases carries part of the load of the superstructure. Rollers on the circular track carry the remaining portion of the load. The bridge is balanced wherever possible by placing the turntable at the center of the span, in which case two channels are provided for navigation, one on each side of the pivot pier. In cases where it is undesirable to locate the pivot pier in the center of the channel, one nd of the bridge is made longer than the other and the short end is counterweighted so as to bring the centre of gravity of the while moving structure at or near the centre of support. Where such a bridge is used only one channel is provided. The pivot pier is set on one bank and the long arm of the bridge spans the channel leaving the full width open to navigation. Where two such bridges are used together, one on each side, a very wide channel can be obtained. Where this arrangement is used, the shore ends of the spans must be anchored, when closed, to prevent the moving leaf from tip-

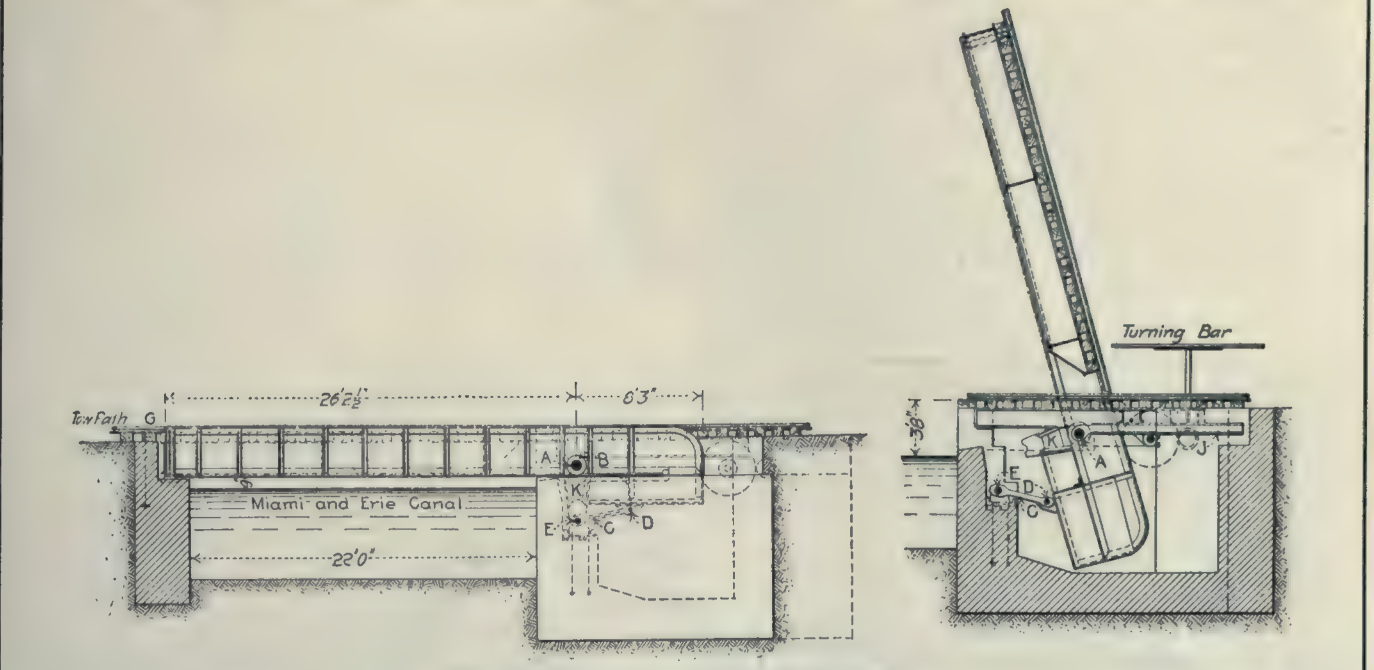


Fig. 5.—Single-span bascule bridge at Delphos, Ohio.

ping under the action of live load on the channel end.

The trusses acting as cantilevers will deflect under the action of the dead load while swinging so as to hit the end supports when the bridge is swung shut, unless some provision is made to lift the end of the bridge above its normal position when it is opened. This is done in a number of different ways. Besides with a centre circular track are lifted bodily by hydraulic pressure, or the ends are lifted by shortening an adjustable section of the top chord at the centre or by means of a toggle mechanism at the ends.

When the adjustment of the end supports is such as to cause them to take only a portion of the dead load, leaving the balance to be carried by the trusses acting as cantilevers, the trusses are in reality continuous over the centre support. Such a design is economical but a slight variation in the adjustment of the supports from what has been assumed causes such a variation in the resulting stresses that the scheme is not entirely satisfactory. For this reason engineers are inclined to sacrifice whatever gain may result from the continuous girder effect by providing an adjustable panel in the top chord at the centre by which it may be relieved of all stress when the bridge is closed, thus causing the two ends of the bridge to act as separate single spans. The uncertainty of the continuous girder effect has also been eliminated by adjusting the end supports so that the ends of the trusses will just touch, but transfer no dead load to them when the bridge is closed. This causes the trusses to carry the dead load as cantilevers and the live load as continuous trusses.

The double leaf swing bridge at Tarante, Italy, has pivot piers clear of the channel. The shore or short arms of the trusses are counterweighted so as to balance the long arms when the bridge is swinging, and are anchored to the masonry when the bridge is closed so as to prevent the bridge from tipping under the action of the live load on the channel arm. The curved bottom chord gives an arch effect which is very pleasing in appearance.

A similar bridge over Penfeld River at Brest, built in 1861, provides a clear channel of 350 feet, which was the record width for a clear channel provided by a

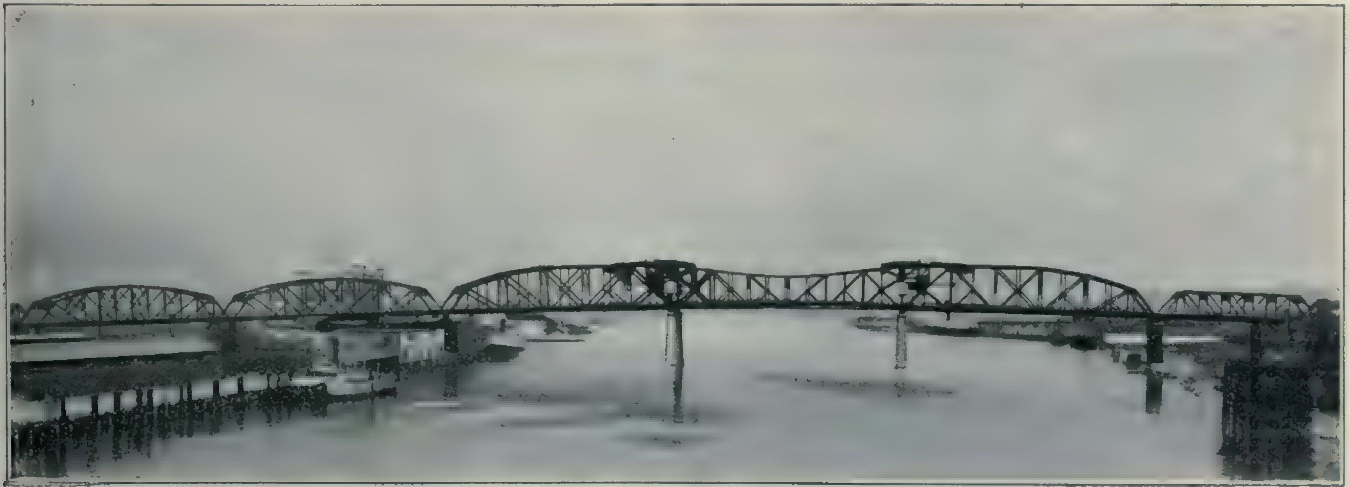


Fig. 5a.—Broadway bridge, Portland, Ore.

movable bridge until the new vertical lift span over the Missouri River at Kansas City was completed in 1912. A swing bridge at Havre has two leaves with unequal arms. When closed the short end is anchored to the masonry, after which the centre support is lower so as to transfer the load to the masonry at the front edge of the abutment where proper support is provided. This method of supporting the bridge when closed reduces the length of the cantilever subjected to live load, throws the point of support a considerable distance in front of the centre of gravity of the superstructure thereby reducing the live load moment to be balanced by the anchor, and increases the effective lever arm of the anchor so as to greatly reduce the stress to which it is subjected.

Figure 1 shows two swing bridges over the Missouri River at Omaha, which carry the double track of the Omaha Bridge and Terminal Railway Company Each swing span is 520 feet long, longer than any other movable bridge in the world. The bridge was completed in 1903. Waddell & Harrington were the consulting engineers. Most American swing bridges with centre pires are of this general type.

The Joliette Bridge in the port of Marseilles has a moving leaf which turns about a pivot supported on a hydraulic ram. The shore end of the truss, which is shorter than the channel end, carries wheels which run on a track on the shore. The bridge is very close to the water and most of the traffic on the canal consists of low barges. To permit of the passage of these barges without swinging the bridge, the hydraulic ram which carries the pivot is raised, thereby raising the front or channel end. This gives ample head room for the passage of the barges. The bridge was built in 1878.

The main road from Chester to Manchester crosses the River Weaver at a point where the surface of the ground is gradually subsiding due to the mining of salt in the district. For many years a plate girder swing bridge was in operation, but its gradual subsidence, averaging 4½ inches per year for 16 years, had reduced the clear head room until it became necessary to replace the old bridge with a new one, giving greater head room. One of the main points which had to be considered in designing the new bridge was the impossibility of preventing a concentrated load from settling under the action of its own weight.

In order to prevent settling, the bridge was supported on a floating pontoon whose buoyancy, which could be varied at will, was somewhat less than the weight of the superstructure. This pontoon had an air-tight deck 1 ft. below normal water so that neither its buoyancy nor elevation was affected by the level of the water. The pontoon, which turned with the bridge to which it was rigidly attached, floated in a chamber provided for the purpose and was surrounded by cast-iron piles which carried a gridiron girder. This gridiron girder supported a track and the portion of the weight of the superstructure not carried by the pontoons was carried on a series of rollers running on this track. The track served the further purpose of keeping the bridge properly centered. By keeping the buoyancy properly adjusted the portion of the stream bed under the point of support of the bridge was subjected to but little greater load than at other points. The load on the rollers was also comparatively light and the friction to be overcome in operating the bridge correspondingly small.

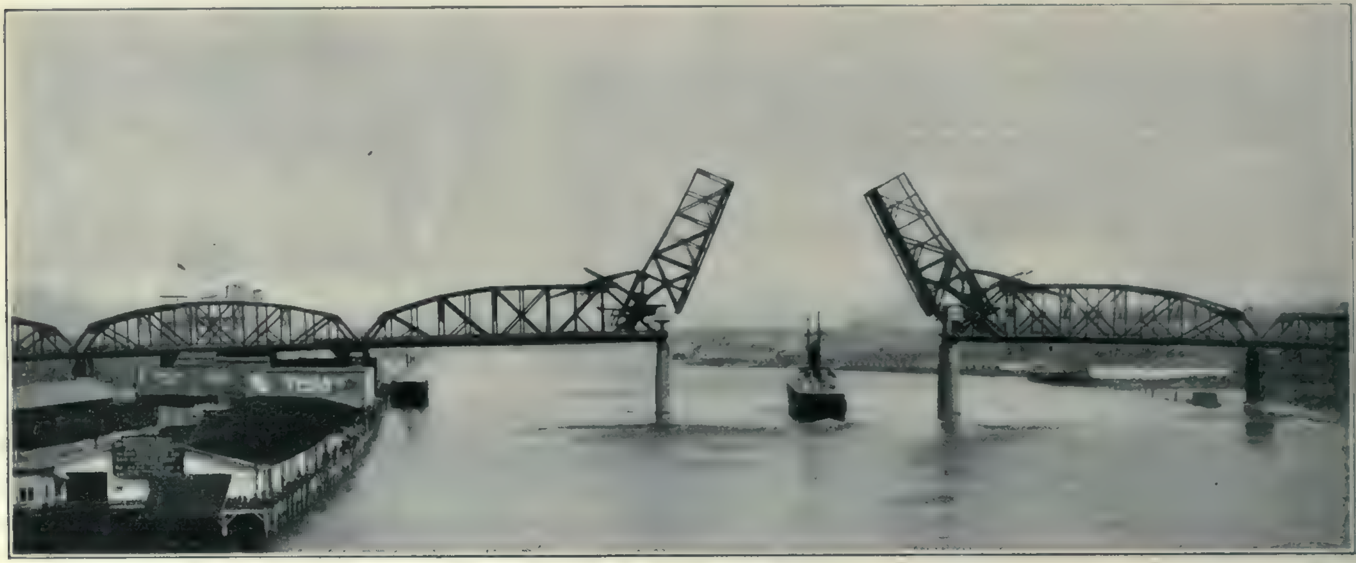


Fig. 5b.—Broadway bridge, Portland, Ore.

In 1893, in anticipation of the building of this bridge, the engineer in charge, Mr. John Arthur Saner, converted a cattle bridge in the same neighborhood into the type just described, and upon its proving satisfactory the larger bridge was built and put in operation in 1899.

Conditions similar to those governing the design of the bridge over the River Weaver near Manchester were found at the crossing over the Hoogly, that connects Calcutta with Howrah. The present pontoon bridge, which was built in 1874, is to be replaced by a modern bridge. The river bed is soft mud and the swift current scours so badly that it is practically impossible to put a pier in the channel. The old pontoon bridge has been satisfactory, but there are drawbacks to this type of bridge for so important a point which make it undesirable to repeat the design. A substitute has been proposed in the form of a double leaf swinging bridge on floating piers. Two such designs have been submitted. For one design, the shore ends of the two approach spans rest on fixed abutments and the stream ends of the approach spans and the swinging spans rest on a floating pontoon which rises or falls as the water level in the river changes. For the other design, the bridge is supported in a similar manner except that the pontoons which have a buoyancy greater than the maximum dead load plus live load are anchored into the river bed so as to be slightly submerged when the water is at low level. These anchors prevent the pontoons from rising and falling with the water level in the river and the bridge is at a fixed level at all times. This system is the invention of Mr. F. Forssell and the patent rights are held by Head, Wrightson & Company, Limited.

In addition to what are usually known as swing bridges, there have been a number of other types of movable bridges built which open by rotating about a vertical axis.

One of these is known as a bobtail swing bridge. The pivot is at the extreme end and the weight of the moving leaf is balanced by an overhead counterweight atttached to the rear end. A bridge of this type carries the C. M. & St. P. Railway over Ogden Canal just off the North Branch of the Chicago River at Cherry St. It was built in 1902. This road has other bridges of the same type.

A type of temporary wooden bridge which has been used by the New York, New Haven & Hartford Railroad consists of four wooden deck trusses, each of which is pivoted to a swing in a horizontal plane. These trusses are all pivoted to a swing beam near their front end. Rods fastened to this swing beam pass up to the top of a tower and support the outer ends of the trusses as the bridge is moved. When the bridge opens, the trusses swing together and in the open position are just far enough apart to clear. The tower is prevented from tipping forward when the bridge is in the nearly closed position, by tension rods which run from the top of the tower to the top of a group of piles. It is prevented from tipping sideways when the bridge is open, by a stiff-leg frame on the compression side and a tension rod on the tension side. Provision is made for lifting the front end of the trusses a few inches before opening the bridge so as to clear the support. The bridge is operated by hand. When it is closed the front end rests upon pile bents and the live load is carried the same as for a simple span.

The Miami and Erie Canal Transportation Company, of Cincinnati, Ohio, has a charter for operating the canal by electric towage, using trolley locomotives on a track along the towing path. At several points the track crosses the canal, and in order to make the curves as easy as possible the crossing is made on a skew bridge, of a type designed by Mr. Ward Baldwin. It was desired to build these bridges as cheaply as possible. The bridge consists of two parallel plate girders pivoted at one end and supported on vertical posts at the other. The heels of the girders are connected by a semi-circular drum which rests on rollers. Two I-beams framed between the two girders carry the centre bearing. The posts under the outer end of the girders are carried on rollers which run on a circular steel track supported on piles at the bottom of the channel. The operating pinion is carried on the lower end of the post and meshes with a rack concentric with and just outside of the steel track. A recess is cut in the side of the canal to allow the end post to swing back and leave the channel clear when the brige is open. The bridge can be operated by electric motors or by hand.

A temporary bridge which was built over the Chicago River to accommodate pedestrians while the new permanent bridge at State Street was being erected, swings about a pivot supported on timber piles at one end and is carried on a pontoon at the other. This design was submitted by Roemheld & Gallery.

A horizontal automatic swing bridge, which is used on a canal near Bordentown, N.J., consists of a single leaf horizontal swing bridge with a counterbalanced short arm. The track is slightly inclined toward the canal, and the centre of gravity of the moving parts is between the centre of rotation and the channel so that when the bridge is opened the centre of gravity is raised. The weight of the bridge makes it swing shut. There is no one to tend the bridge, it being opened by the canal boat pushing against it, and is closed by its own weight. A number of similar bridges are in use on the Ohio State canals.

What is known as the Victoria Bridge is one of the largest horizontal rolling bridges which have been built. The moving leaf is carried by lattice girders which are supported by the approach span. The chan-

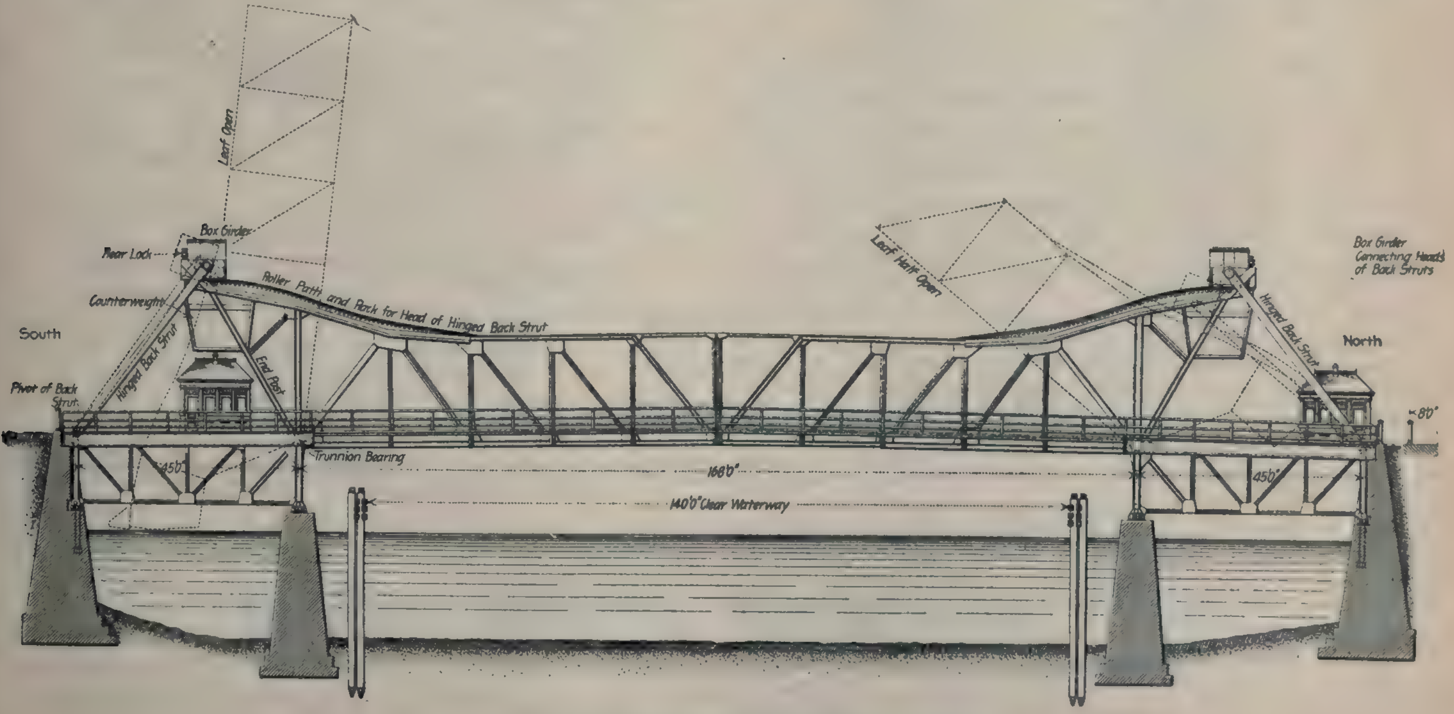


Fig. 6.—Bascule bridge at Ashland avenue, Chicago.

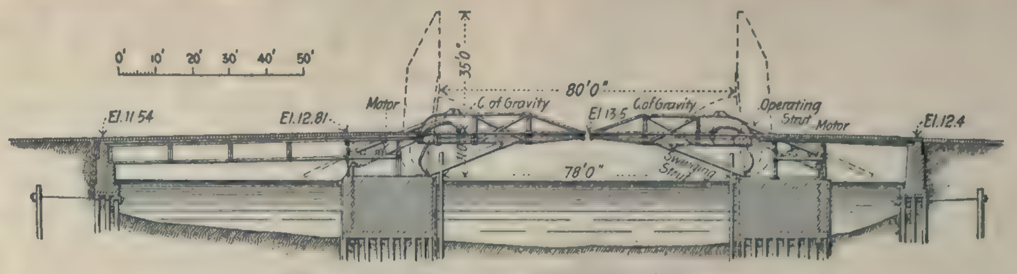


Fig. 7.—Huron street bridge, Milwaukee, Wis.

nel ends of the girders are balanced by counterweights on the shore end. To close the bridge the moving leaf telescopes so as to allow it to pass beneath the floor of the approach span. It is then rolled back on wheels which run on a track supported by the approach girders. The design was made by Mr. T. W. Barber and was selected from among eighteen designs submitted. The bridge was formally opened to traffic by Mr. Gladstone, June 2, 1897.

A wooden horizontal draw bridge designed by Mr. C. E. Burroughs, of Norfolk, Va., is applicable to short spans. It consists of a stringer span mounted on a carriage which travels on an inclined steel track. The carriage is inclined so that the floor of the moving leaf is always horizontal. When the bridge is closed the front end of the moving leaf rests on a pile bent and the live load is carried the same as on a simple span. When the bridge is to be opened, the hinged door in the floor is lifted and fastened to a hook provided for the purpose and the carriage is drawn back on the inclined track. The combination of the inclined track and hinged door in the floor allows the moving leaf to clear the approach span as the bridge is opened. The front end of the bridge is supported in the open position by means of tie rods passing over a gallows frame. The moving leaf is counterbalanced by a second carriage loaded with ballast and running over a track inclined in the opposite direction from the one which carries the moving leaf. These two carriages are connected by a steel cable. The bridge is operated by hand.

A horizontal rolling bridge has just been constructed over the Milwaukee River at Oneida street, Milwaukee, to take care of the foot traffic at this crossing while the new permanent bascule bridge is being erected. It consists of two through trusses carried on a counterweight carriage which runs on a track supported on piles. The bridge is opened and closed by running this carriage back and forth on the track. In the closed position the front end of the bridge rests on the dock and the live load is carried the same as in the case of a simple span. The approach span on the same side of the channel as the track is a platform parallel to the track. The pedestrians go from the platform to the deck of the bridge by passing through the next to the end panel of the truss, from which the diagonal bracing has been omitted. The shear on this panel has been taken care of by a plate-girder in the top chord. The passage to the dock at the opposite end of the bridge is the same as for an ordinary span. This bridge was designed and constructed under the supervision of Mr. L. J. King, as superintendent of bridges and public buildings.

In cases where the street traffic is light and the water traffic is heavy so that the latter should be given more consideration than the former, use is made of what has been called transporter bridges. One of the more important examples of this type of bridge is the one over the Ship Canal at Duluth, Minn. This bridge consists of two structural steel towers about 400 feet apart between which is a track carried by steel trusses. This track supports carriages which run back and forth across the channel. Platforms with decks level with the roadway on either side of the channel are suspended from these carriages by means of a steel frame. When pedestrians or teams wish to cross the channel, they walk onto this platform and the platform is carried across the channel by the carriage to which it is attached. The clear headroom over the water is 135 ft. The bridge was built in 1904 and 1905. Other bridges of the same type have been in successful operation at other points.

Another type of transporter bridge crosses a narrow arm of the sea between St. Malo and St. Servan, on the north coast of France. At low tide the bed of the sea is bare. A track was laid on the bed from dock to dock and a carriage conveying a platform on the top of a steel tower, travelled back and forth across the channel. The bridge was operated during high tide and in currents due to a tide of 5 or 6 nautical knots. This bridge was devised and built by Mr. Leroyer, a local architect, about 1871, and was successfully operated for a number of years.

As has been previously stated, bascule bridges were used in the early days as a means of defence. They have been used to a limited extent to provide crossings over navigable streams since early in the 19th century, but their use was not common until the adoption of the bascule type for the new London Bridge. The general scheme of this bridge is shown in Fig. 2. The draw span is a double leaf bascule bridge supported on fixed trunnions and counterbalanced by counterweights attached to the shore end at such a point as to make the centre of gravity of the whole moving structure fall at the centre of the trunnions. Each leaf is supported on four lattice girders. Instead of each girder being supported on a separate shaft the four girders of each leaf are supported on a single shaft 21 in. in diameter and 48 ft. long. This shaft is supported on eight journal boxes with steel roller bearings. These journal boxes are carried on curved girders, one on each side of the bascule girders, which rest upon the front and rear walls of the trunnion piers. By curving these girders up at the shore end the counterweight falls below the bascule girders and does not interfere with them when the bridge is opened. When the bridge is closed, a resting block in front of the trunnion comes in contact with a live load support and the tail end is anchored to the masonry so that the moving leaf acts as a cantilever. The effect of the front support is to relieve the trunnion of the live load and to reduce the stress on the anchors. The bridge is operated by a pair of pinions which mesh with a rack quadrant fastened to the tail end of the girders. The clear channel is 200 ft. and the distance centre to centre of trunnions is 226 ft. 6 in. The counterweight is composed of lead and cast iron.

Mr. William Scherzer invented a rolling lift or bascule bridge but died before any of his bridges were constructed. After his death the design was taken up and a large number of his bridges, usually known as the Scherzer Rolling Lift Bridge, have been constructed and are now in use. The first one of these bridges was built in 1895. It is shown in Fig. 3. The bridge consists of two leaves, each of which is supported on two trusses. The tail ends of these trusses are in the form of a circular arc and rest on tracks carried by the foundation, counterweighted so as to bring the centre of gravity of the moving leaf at the centre of the circular arc. The bridge is opened by rolling the circular arc on the track on which it rests. Since the centre of gravity is at the centre of the arc it is not raised or lowered as the bridge is moved, and all the work which has to be done is that required to overcome the wind, friction, and the inertia of the moving part. Since the moving leaf rolls back as it is opened, the front end does not overhang the channel, and the angle of opening and the length of span can be reduced to a minimum. When the bridge is closed the tail end is anchored to the foundation and the live load on the front end is carried by the bascule trusses acting as cantilevers. Where there is sufficient headroom over the channel to permit of the use of a deck bridge quite pleasing effects may be obtained with this type. Fig. 4 shows the 212 ft. double leaf highway and electric railway bridge over the Connecticut River at Saybrook, Conn. The outline of this bridge gives an arch effect but the load is carried as a cantilever.

A Scherzer bridge carries the double track of the Tehauntepec National Railways of Mexico across the harbor at Salina Cruz, Mexico. When the bridge is closed a pin at the end of the top chord of one leaf engages a pin bearing at the end of the top chord of the other leaf. Pin bearings are also provided where the moving leaves rest upon their supports when in the closed position so that the bridge is supported at the three points and the two leaves act together as a three-hinged arch to carry the live load. A number of double leaf bascule bridges not only of the Scherzer but of other types, act as a three-hinged arch to carry the live load.

There are a number of Scherzer Rolling Lift Bridges worthy of note. The double track, double leaf railroad bridge over the Chicago River at Taylor Street, Chicago, built in 1901, is the longest double leaf cantilever bascule railroad bridge ever built. It has been subject to very heavy railroad traffic and to frequent operations for a period of thirteen years and is still in use. A similar bridge which has just been completed forms the only connection between the Island of Ceylon and the mainland of India.

Another Scherzer Rolling Lift Bridge, notable because of the number of bridges together, is the one known as the eight track bridge over the Drainage Canal near 31st street, Chicago. The eight tracks of the Pennsylvania Railroad, the Baltimore & Ohio Railroad, and the Chicago Junction Railway are carried on four independent bridges placed side by side. By having adjoining bridges pointing in opposite directions, the tail of one on the same side of the channel as the front end of the other, the tracks are spaced a minimum distance apart.

There are three multiple bridge Scherzer Rolling Lift Bridges on the main line of the N. Y., N. H. & H. Railroad between New York and Boston. Each crossing is composed of three double track bridges placed side by side.

Figure 5 shows the bridge which carries the Pittsburg, Fort Wayne & Chicago Railway over the Miami and Erie Canal at Delphos, Ohio. This bridge, which is of the single leaf bascule type, is counterweighted so that the centre of gravity of the moving leaf is at A, the centre of the shaft about which the leaf rotates. A strut C is pivoted to the lower side of the girder at D and to the masonry at E. The shaft A carries the wheels B, for which a track is provided on the top of the masonry. When the bridge is closed the pedestal K rests on the pin E and lifts the wheels B off the track. To open the bridge the shaft A is pulled back

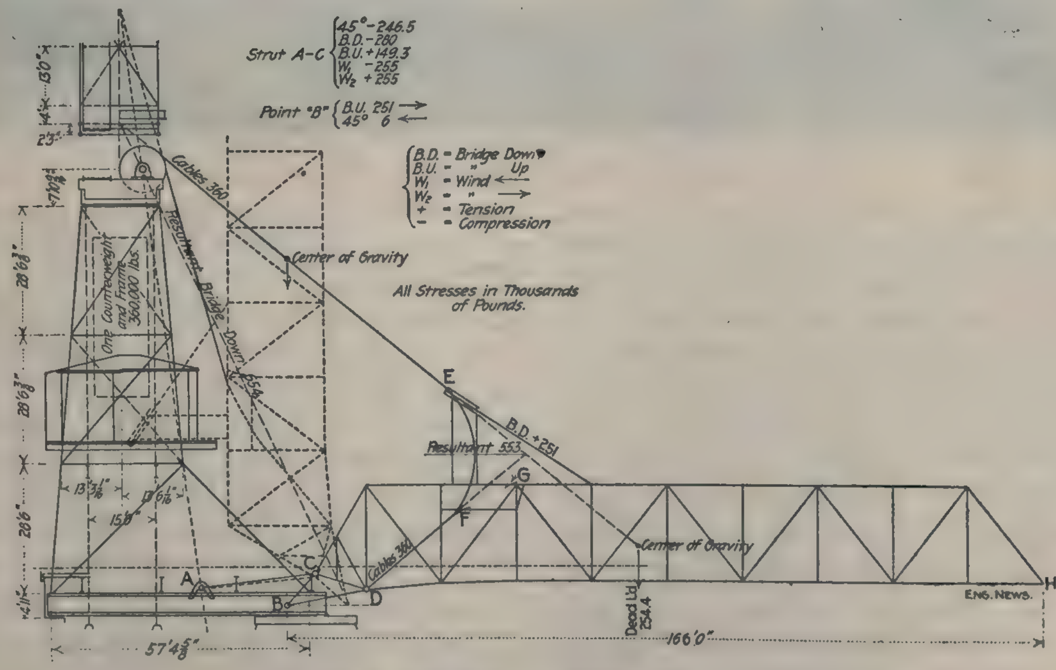


Fig. 8.—Bascule bridge at Ohio street, Buffalo, N. Y.

horizontally by the operating strut J. The moving leaf revolves about E until the wheels B come in contact with the track, after which the shaft A moves horizontally and the leaf moves about A. This horizontal motion has the effect of pulling the upper part of the moving leaf back away from over the channel, thus reducing the length of span required for a given channel and also keeping the counterweight away from the front wall of the counterweight pit. This bridge, which is the first one of its type, was designed and erected by the Strobel Steel Construction Company of Chicago in 1901. It was invented by Theodor Rall. Through bridges of this type have also been built.

The largest bridge of this type is the one known as the Broadway Bridge, Portland, Oregon. It is 70 feet wide and 278 feet long centre to centre of rollers. At the time it was built it was the largest bascule bridge in the world. Another Rall Bridge crosses the Neva.

Figure 6 shows what is known as the Page Bascule Bridge invented by John W. Page, of Chicago. The bridge shown, the first one built of this design, is over the Chicago River at Ashland Ave., Chicago. It consists of two pairs of through cantilever bascule trusses and two pairs of deck approach trusses. The bascule trusses are pivoted on the trunnions supported on the end posts of the approach spans. The shore ends of the bascule trusses extend back of the trunnions and are connected to the approach trusses by means of hinged anchor struts. These struts are hinged to the approach girders at the lower end, and the near and far struts are connected at the upper end by means of a heavy box girder to which they are pivoted. This box girder is supported on a pair of rollers at each end which run on the curved top chord of the bascule trusses. This box girder carries the operating machinery which transmits the power to operating pinions, one for each truss of each leaf. These pinions mesh with the racks which are fastened to the top chord of the trusses. The counterweights which balance the bridge are of two parts,—one part is rigidly attached to the tail end of the bascule truss, and the other is carried on the box girder. The first part has a fixed position and the second has a changing position relative to the trunnion and the centre of gravity of the moving leaf. By properly proportioning the different dimensions and properly shaping the curved track on the top chord of the bascule truss the bridge can be balanced in all positions.

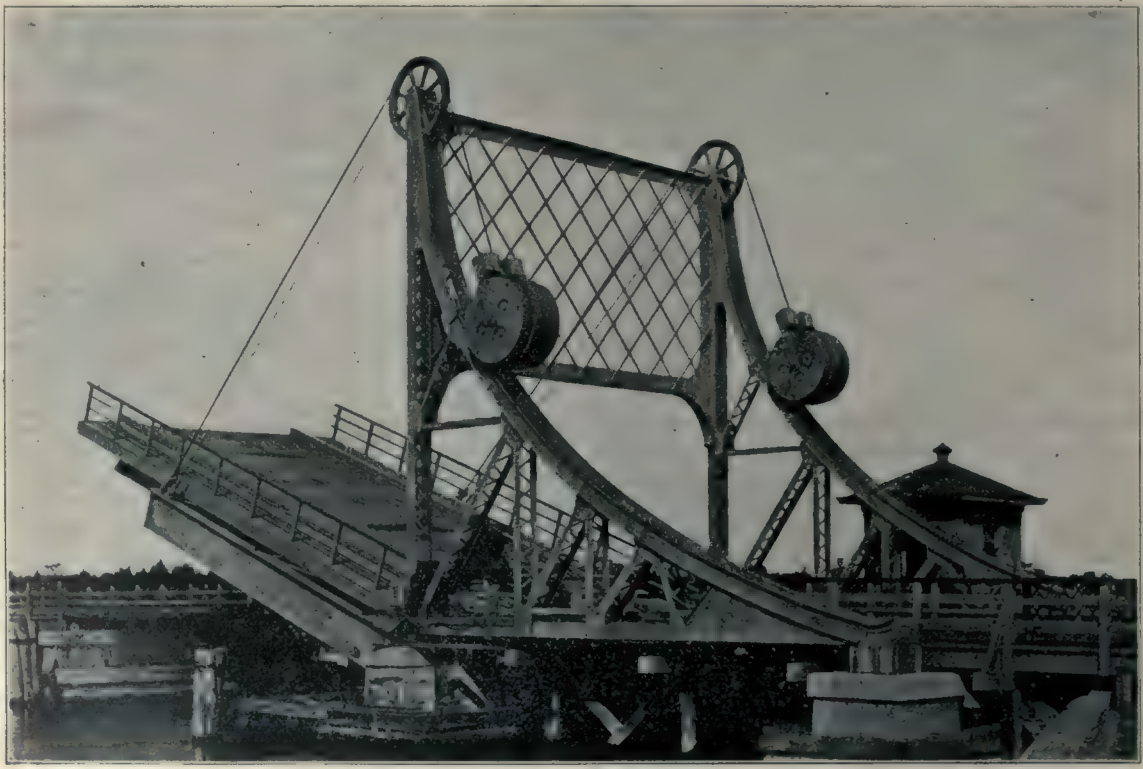


Fig. 9.—Harway avenue bridge, Brooklyn, N. Y.

A late adaptation of the Page patent is low and has semi-through trusses which greatly reduce the objectionable appearance of the Ashland Avenue bridge. The moving leaf is balanced by the approach span which is pivoted at the shore end and is carried by a segmental rocker at the trunnion end. This rocker rolls on a curved surface on the heel of the bascule trusses of such shape as to cause the bridge to be balanced in all positions.

A bridge built at Huron street, Milwaukee, Wisconsin, is shown in Fig. 7. It is a double leaf bascule bridge but the motion of the moving leaf instead of being a motion of rotation about a fixed axis is a combined motion of rotation and translation produced by a pivoted link and a curved guide. A large triangular supporting girder is rigidly anchored to the masonry. A strut or link is pivoted to this supporting girder at its lower left hand corner. At the upper left hand corner is a pair of rollers mounted on pins. The upper end of the strut is pivoted to the lower side of the main bascule girder. The tail end of the bascule girder shaped to a smooth curved surface is rigidly supported by web plates and rests upon the rollers carried by the supporting girder. The moving leaf is counterweighted so as to bring the centre of gravity between the supporting rollers and the strut pivot in the bottom of the bascule girder. This causes the curved surface to be pressed firmly down on the rollers. As the bridge opens the centre of the upper strut pin, a point in the bascule girder moves in a circle about the lower strut pin as a centre. The curved surface moves along over the top of the supporting rollers. The motion of the centre of gravity of the moving leaf is a combination of the two motions just described and by properly laying out the curved surface it can be made to move in a straight horizontal line. With such a motion the bridge is balanced in all positions. The moving leaf is acted upon by three forces, axial compression in the strut, normal pressure of the roller against the curved surface, and the weight of the moving leaf acting vertically through its centre of gravity. For the bridge to be balanced these three forces must intersect at a common point. As the bridge was built, the tail end of the bascule girder was allowed to strike against a support when in the nearly open position and relieve the pressure on the roller. When the bridge is closed the moving leaf acts as a cantilever and the strut and roller hold the bridge in position against the action of the live load. This design was made under the supervision of Mr. Geo. H. Benzenberg, then City Engineer for the city of Milwaukee. The bridge was opened for traffic January 1, 1897.

The various bascule bridges described support the channel end of the moving leaf on the bascule trusses acting as cantilevers. This produces large dead load stresses in the bascule trusses, necessitates the use of comparatively short counterweight arms, and makes it necessary to carry the weight of the counterweight as well as the weight of the moving leaf upon the trunnions. By supporting the channel end of the moving leaf on a cable passing over a pulley at the top of a tower and fastened to a counterweight the counterweight arm is increased, the weight of the counterweight and part of the weight of the moving leaf is removed from the trunnion and the dead load, and in some cases the live load is carried on the bascule girders acting as simple beams. There is the disadvantage, however, that this type of bridge requires the use of a tower which is expensive and usually unsightly.

One bridge of this style built over the Buffalo River at Ohio street, Buffalo, New York, in 1907, was designed by Mr. Brown. A diagrammatic sketch is shown in Fig. 8. The bridge is a single leaf bascule hinged at the point C and balanced by means of a counter-weight supported on a cable attached to the moving leaf and passing over a large pulley at the top of a tower. The cable is attached to the moving leaf at the point D and passes over the curved guide F E. The pivot C instead of being fixed is connected by hinged struts to the fixed point A and the point B which is free to move between horizontal girders. A hydraulic piston moves the point B horizontally. This raises the point C and causes the moving leaf to revolve about C. As the leaf is raised the moment of its weight decreases. The curve of the guide E F is laid out so that the counterweight acting through the cables produces a moment which varies as the moment of the moving leaf so that the bridge remains balanced in all positions. When the bridge is fully open, forked guides at G straddle the cable and prevent the leaf from falling onto the tower. When the bridge is closed it carries the live load as a simple span.

The bridge at Harway Ave., Brooklyn, N.Y., is shown in Fig. 9. It is a single leaf bascule bridge with fixed trunnions. To balance the bridge a steel cable attached to the bascule girder passes over a large pulley at the top of a tower and is attached to a counterweight which rolls on a curved girder. This girder is so formed as to cause the counterweight to balance the moving leaf in all positions. When the bridge is closed it carries the live load as a simple span. The bridge was designed by Mr. Joseph Mayer; Mr. E. S. White was the engineer in charge, and Mr. J. S. Langthorn was Resident Engineer of Construction. It was completed in 1898. A bridge of this type was built at Michigan Ave., Buffalo, N.Y., in 1897 and is still in use. A number of other bridges of the same type have since been built.

(The concluding portion of this article—Part II—will be published in our next issue.)

Ultimate Strength of Carbon-Steel Models of Quebec Bridge Members

Diagrams of Destructive Tests; Anchor Arm Lower Chord Models Buckled Under Unit Load of 50,886 Pounds

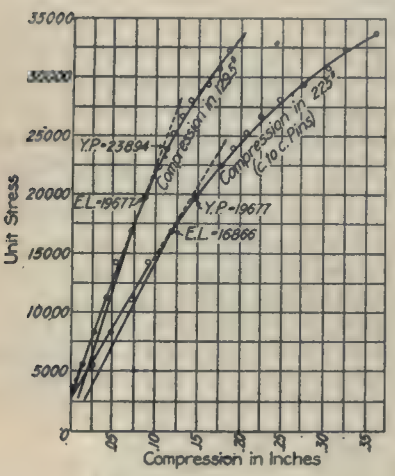
AMONG the eighteen tension and compression tests of models to a scale about one-quarter the natural size of the members of the trusses in the 1800-ft. span of the new Quebec Bridge which have recently been made there are four sets on carbon-steel sections of the compression lower chords L10-12 in the anchor arm. These members have the same position in the truss as those which failed in the Quebec Bridge collapse several years ago. In the new bridge structure they are proportioned for heavier total loads and for smaller unit stresses, and their design differs materially from that of the corresponding members in the former structure, which had four deep vertical webs connected only by end diaphragms and by top and bottom chord latticing.

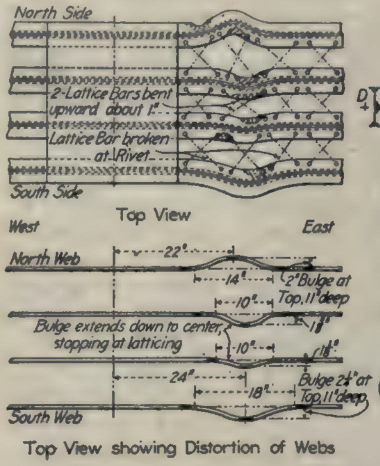
The models of the new bridge members have been made and tested in the interest of the accepted design, which has been prepared after investigation of similar members in the other largest recent spans and may be considered as the latest development in compression members to resist excessively heavy stresses in long-span trusses.

Models

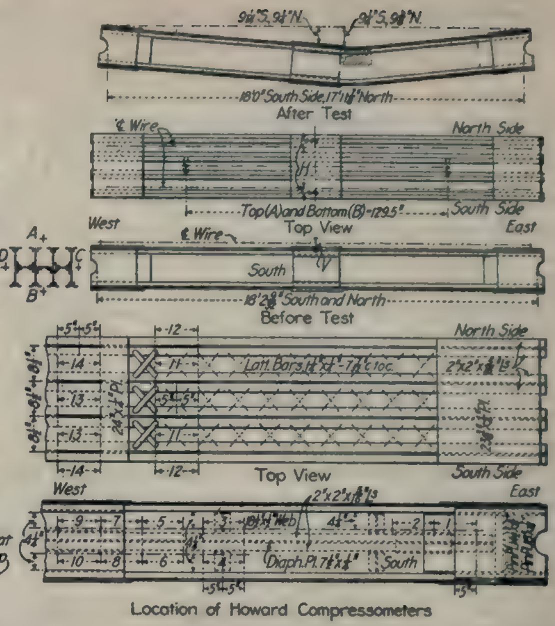
The models, about 30 in. wide, 18¾ in. deep and 18 ft. 9 in. long, weighed from 7610 to 1650 lb. each and were marked TX13-A, B, 1 and 2. They had four deep vertical webs connected by full-length horizontal longitudinal latticing and tie plates on the centre line and on the top and bottom flanges. They had a ratio $L/R = 38$ and a nominal cross-sectional area of 70.65 sq. in., which, however, owing to the inaccuracy of rolling the plates and angles, was reduced to an actual area of about 69 sq. in., making the sections a little more than 2 per cent. light. Specimen tests made from the plates and angles showed an elastic limit varying from 39,780 to 42,700 lb. They had half-hole bearings in both ends of the webs, which

Compression diagram and manner of failure of model TX13A-1 and location of compressometers.




North Side
2-Lattice Bars bent upward about 1"
Lattice Bar broken at Rivet
South Side
Top View
West
East
North Web
22"
14"
2" Bulge at Top, 11" deep
10"
Bulge extends down to center, stopping at latticing
10"
24"
18"
Bulge 2¼" at Top, 11" deep
South Web

Top View showing Distortion of Webs



Location of Howard Compressometers

were reinforced to give 52 sq. in. of bearing for the 6½-in. pins.

The accompanying illustrations are of special interest in that they include the first published details of the bottom chords of this great span. All of the models were symmetrical about their centre transverse axes and those marked A were made with both ends exactly like the left-hand end of the illustration, with the flanges of the centre webs connected by lattice bars. The models marked B were exact duplicates, except that they were made with both ends like the right-hand end of the illustration, with the flanges of the middle webs connected by tie plates. The models were supported by end pine alone, without intermediate counterweights to carry part of the weight.

General Results

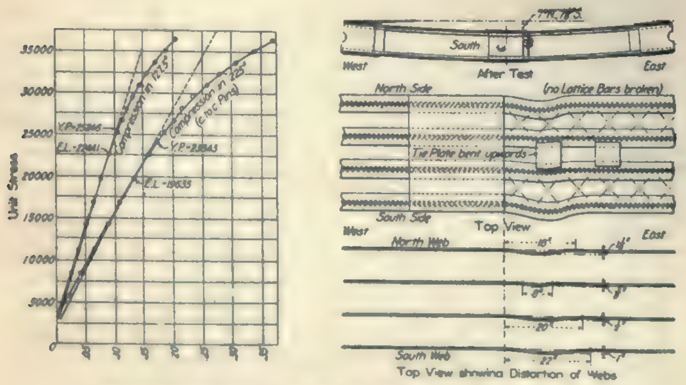
The elastic limit of the models, taken as a whole, varied from 16,866 lb. to 22,441 lb., and in all except the last case was much lower than the elastic limit determined on a long length measured in the centre of the member. One model failed with a maximum unit load of 39.359 lb. The other three models endured without failure several repetitions of the maximum load of the 2,800,000-lb. capacity machine. Afterwards they were weakened by holes drilled through the webs near the centre of the piece, and failed under loads of from 43,060 lb. to 50,886 lb. per square inch computed on the reduced sections.

Model TX13A-1 failed by lateral deflection in the planes of the webs and by buckling of the webs near the centre of the piece.

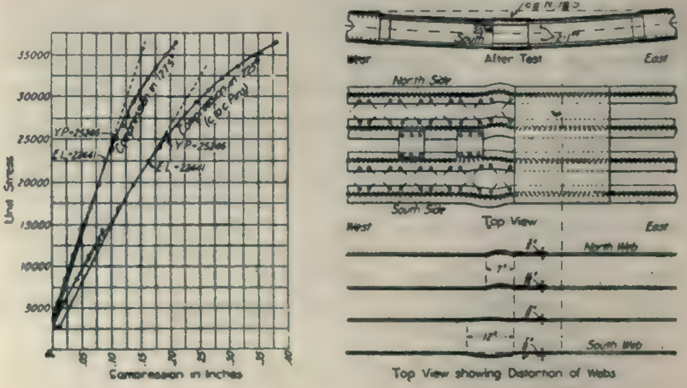
Model TX13A-2 was compressed to the full capacity of the machine, which produced a stress of 40,657 lb. without failure. Afterward two 1-in. holes were bored through each of the four webs near the centre of the piece, reducing the section from 68.87 to 64.87 sq. in., and the same maximum total load was applied three times at high speed, producing a unit stress of 43,164 lb. per sq. in., and on the third application caused the failure of the model by a downward deflection and the buckling of the webs near the centre. The strain gage locations were all made on one latticed face of the model, none of them being made on the webs.

Model TX13B-1 endured without failure the full load of the machine, producing a compression of 40,565 lb., after which two 1-in. holes were bored through all four of the webs near the centre of the model, reducing the sectional area from 69.026 to 65.026 sq. in., and the same maximum load was applied again seven times at high speed, producing a stress of 43,060 lb. and finally causing the failure of the piece by bending at the centre in the plane of the webs and by the buckling of the webs near the centre. The strain gauges were applied at ten points on the webs on both sides of the model and at eight points at the upper latticed face.

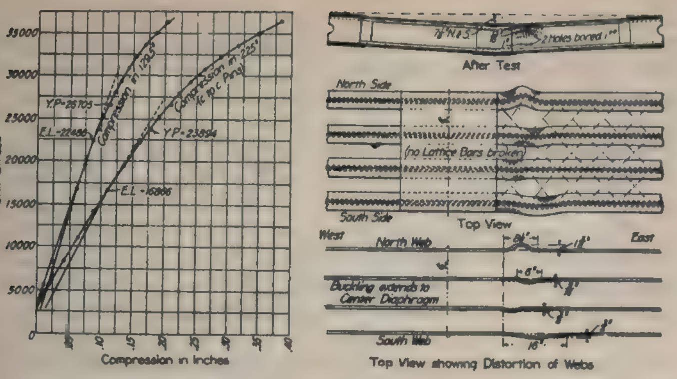
Model TX13B-2 was loaded to the full capacity of the machine, gauge 867.7, producing an ultimate compression of 40,565 lb. on the full section of the piece, which it endured without failure. The pressure was released and two 1-in. holes were bored through all



Compression diagram and manner of failure of model TX13A-2.



Compression diagram and manner of failure of model TX13B-1.

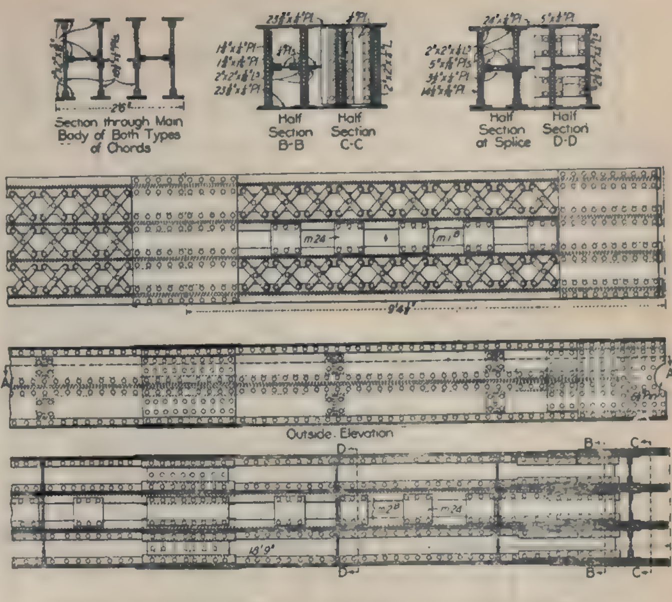


Compression diagram and manner of failure of model TX13B-2.

Mark	Elastic limit In portion of member at center	 In full length	Ultimate strength	Percentage model is light of nominal weight	Max. vert. deflection at center, inches Before test	 After test	Date of test, 1913	Time of test readings First	 Last
	Pounds per square inch								
TX12A1.......	19,677	16,868	39,350	2 51	3/64	7 4/32	February 28	1.55 P.M.	5.26 P.M.
TX13A2	22,488	16,886	43,164	2 51	1/32	7 1/8	March 4	9.27 A.M.	1.14 P.M.
TX12B1	22,441	22,441	43,060	2.29	21/64	.. ..	March 3	9.06 A.M.	1.06 P.M.
TX13B2	22,441	19,625	50,886	2 3	1/32	7 1/8	March 5	1.10 P.M.	4.46 P.M.

Compression tests of carbon-steel, lower-chord models.

four webs, reducing the sectional area 4 in., and the same loading was repeated ten times. As this did not produce failure, two more holes were bored and the same loading repeated several times. Finally the section was reduced 14 in. by boring six holes through the two south webs and eight holes through the two north webs and the same load again slowly applied and maintained for 10 minutes, producing a compression of 50,886 lb. per sq. in. on its reduced cross section of 55,026 sq. in. After 10 min. application this load caused the failure of the model by bending transversely at the centre in the plane of the webs, which were buckled somewhat at the location of the holes.



Detail of carbon-steel model of anchor arm, lower-chord section.

Mr. C. N. Monsarrat is chairman and chief engineer and Messrs. Ralph Modjeski and C. C. Schneider are the members of the board of engineers of the Quebec Bridge. The tests were made for the St. Lawrence Bridge Company of Montreal, contractors for the superstructure of the new Quebec Bridge, by the Phoenix Bridge Company, of which Mr. John Sterling Deans is chief engineer, Mr. P. L. Szlapka, designing engineer, and Mr. Charles Scheidl, assistant engineer in charge. The tests were made under the direction and personal supervision of Mr. James Howard, engineer-physicist, Bureau of Standards, Washington, D.C.—Engineering Record.

Bacillus Coli in Water Supply—Its Significance and Importance

By Joseph Race, F.I.C.*

WHILE too much importance has been attached in the past to the presence of b. coli in water used for domestic supplies, it is regrettable that the pendulum is now showing a tendency to swing too far in the opposite direction. The paper of Geo. A. Johnson (Pro. Amer. Waterworks Assoc. 1913), of Johnson & Fuller, New York, is an illustration of this movement. The all too common practice of using arbitrary and empirical methods in the bacteriological examination of water is partially responsible for the present status res, and in this regard bacteriologists have only themselves to blame. As will be shown later, the mere presence or absence of b. coli in an arbitrarily fixed amount of water may have no significance when considered without regard to other circumstances; and in attempting this we are merely opening the way for criticism. The Committee on Standards of the American Public Health Association (1912) evidently recognized the futility of such procedure when they recommended that quantitative estimations should be made of b. coli. They add: "Qualitative results, when viewed superficially, may seem easier to obtain than, and quite as conclusive as, quantitative results; but detailed evidence shows that in general the quantitative tests are by far the most fruitful source of information." It would appear that the committee might have gone further and deprecated the use of qualitative tests except under extraordinary circumstances. This procedure has also had a deleterious effect on those connected with sanitary work, and who, by reason of their lack of familiarity with the technique employed have accepted this sophism. The author believes that, even with all the assistance that quantitative methods of examination afford, it is often difficult to give a sound opinion on the hygienic quality of a water supply, and that it would be folly to revert to the older methods.

There are many points of difficulty surrounding the significance of b. coli, and on several of these the present knowledge is very meagre. Almost everyone is aware that b. coli is common to the excreta of nearly all the higher and lower animals. In cold-blooded animals the occurrence is less constant, and more or less discordant results have been obtained. Dr. Amyot (Trans. Am. Pub. Health Assoc., 1901) concluded that b. coli is not normal in the intestines of fish, and that when present is due to the polluted environment. The tendency among animals generally

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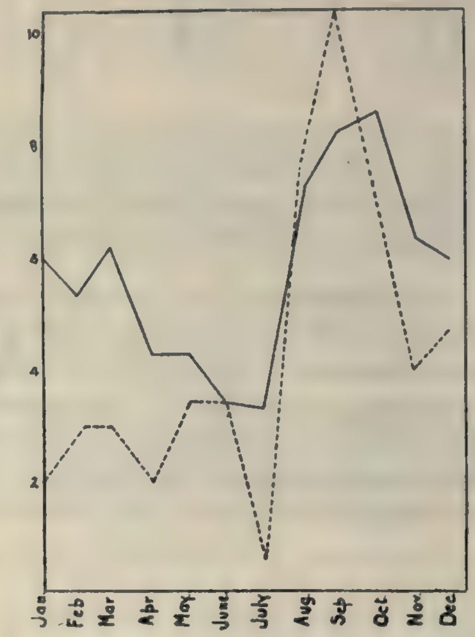
*City Bacteriologist, Ottawa, Ont.

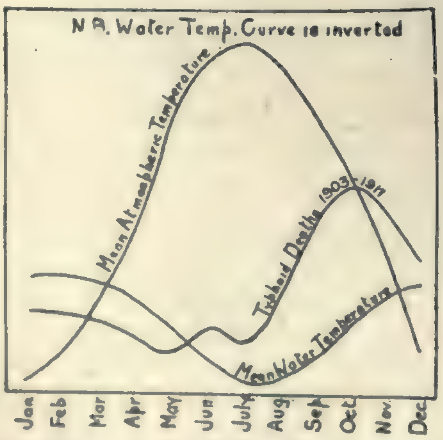


The full line shows average number of typhoid deaths in Toronto each month, 1903 to 1911, before filtration was begun. The dotted line shows the average in 1912-13, after filtration.

is for b. coli to become rarer as the zoological type becomes lower. None of the lower types, however, are susceptible to typhoid fever, man being alone in this respect, so that there is a possibility of having b. coli unaccompanied by b. typhosus. This b. coli has, therefore, no significance.

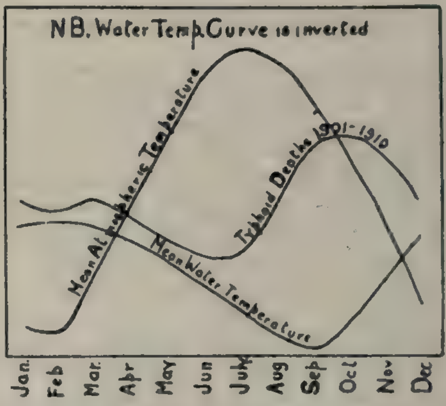
In reference to the b. coli present in a water supply and due to human sources, it is important that information should be obtained regarding the total population on the watershed, the prevalence of typhoid and the probable period elapsing before the diluted sewage reaches the water services of the town under consideration.

The population is comparatively easy to obtain, and the typhoid death rate can, in most cases, be calculated from past records. In addition to the mortality, however, the case incidence should also be considered, as this has an important bearing on the probable ratio of b. coli to b. typhosus by its influence on the number of carriers. In Great Britain and certain portions of Europe the incidence is much lower and the case mortality higher than on this continent, so that the ratio of b. coli to b. typhosus is entirely different. It is possible that this ratio is ten times greater in North America than in Europe, and much greater significance ought, therefore, to be attached to b. coli here.



These curves illustrate the average number of deaths from typhoid in Ottawa each month, 1903 to 1911, compared with the mean atmospheric and water temperatures.

The period elapsing between the discharge of the sewage and the withdrawal of the water is the most important factor, and in this connection the temperature of the water must be considered. Typhoid bacilli, in the absence of suitable food material, find an unsuitable environment in water and, the cell energy being entirely of a katabolic nature, they die rapidly. It is obvious that this increase with the period of storage, and a consideration of the mechanism of the process also leads to the conclusion that the katabolic wasting increases with rise in temperature and vice-versa. Dr. Houston and others have supported this hypothesis, by numerous and conclusive experiments. It is important, therefore, that the bacterial contamination should be considered in its relation to the water temperature, and this leads to the conclusion that b. coli should be regarded as having greater significance in winter than in summer. In the diagram illustrating this point the temperature curve has been inverted so as to conform with the viability of typhoid in water. In both the Ottawa and Toronto diagrams the typhoid death curve and the inverted water curve show a noticeable parallelism in the winter months, and as it is during these months that outside cases are at a minimum, the typhoid incidence is probably water-borne. The plotted figures for Toronto before and after the operation of the filtration plant show that it is this winter rate that has been reduced, whilst the summer prevalence, mostly due to imported cases, has remained unaffected. In Ottawa, with efficient sterilization with hypochlorite, only one case of typhoid has been reported for the first four months of the present year. These results show what can be accomplished by water purification, and also that the significance of b. coli must not be considered in an arbitrary manner.



The average death rate from typhoid in Toronto each month for the years 1901 to 1910 compared with mean atmospheric and water temperatures.

Attempts have been made to belittle the value of the b. coli test because the b. coli content of the water supplies of certain cities did not bear a constant relation to the typhoid death rate. In such statements the sources of the typhoid incidence are not stated, and this, in many cases, may lead to erroneous conclusions.

Advantages of Method in Construction Work

By James L. Stuart, Contracting Engineer, Pittsburgh

PERHAPS there is no business which responds more quickly to what is termed "business methods" than does the average piece of construction work. Certainly there is no business with more diversified interests and trades connected with it than the modern structure, be it railroad terminal, factory, office building, hospital, or hotel.

It has not been more than 20 years, at most, since the construction of buildings was left entirely to practical men who had themselves worked up from positions as artisans or laborers to positions of leadership in constructional lines. Some of these leaders in the past were most talented and even brilliant, but they did not bring with them into the business, except in rare instances, the methods of the trained engineer or the progressive business man, their principal assets being nervous force, executive ability and practical knowledge of the building trades. However, as building construction became more complex and of greater magnitude, the necessity of trained men who understood the engineering problems and who appreciated the application of business methods necessary to bring "order out of chaos" became more apparent, and now both engineering knowledge and modern business methods are most necessary to get proper results as to economy and quality in all of the larger undertakings.

Methods and Organization

In order to successfully construct a building, it is necessary that one should anticipate each step in the progress of its developments and outline a complete system for its erection, including the various steps from the time the drawings are received from the engineer or architect until the building is turned over completed to its owner. The first step in such a process is to make a complete estimate of the cost of the structure from the drawings and specifications, including every item mentioned in the specifications or shown on the drawings. In addition to this there are other small items which are not mentioned in the specifications, but which are necessarily a part of the cost of the building and should be included as such. Under the latter are such items as the cost of administration, liability insurance, temporary buildings, expediting, tools and machinery, and numerous smaller items. These estimates of cost were originally made up by the contractors themselves and were but approximations as compared with the present method of compiling them. In the latter method every advantage is taken of the prevailing market prices when the estimate is made, of the conditions of the labor market, the physical condition under which the work is to be done, and the season of the year. In a properly prepared estimate the unit prices should vary on each individual piece of work, whether figured at the same time or not.

After the estimate has been made of the total cost of the building—and I think an estimate should be made of every building whether the work is to be let on a lump sum contract, cost plus a fixed sum, or on a time and material basis—the next step is to make up a time schedule allowing fixed periods of time for the completion of each part of the building. This must be done most carefully, as on this schedule is based the dates of completion of the different contracts for material and the contracts with sub-contractors for furnishing such portions of the work as are not to be executed by the general contractor's force in the field. This time schedule is made after a thorough study of the drawings, the site of the new project, and a familiarity with the estimate which, as I have said before, gives the quantities of the different kinds of material and assists in estimating the length of time required to complete the various stages of the work.

After the estimate and the time schedule are completed and the contracts for material and labor have been entered into, the real work begins.

A dozen or more sets of drawings are procured from the architect or engineer, a copy of same placed on file in the main office of the builder, one copy sent to the job office and the others distributed among various sub-contractors who have to make up their shop drawings and prepare certain materials to be later installed in the building. A careful record must be kept of these drawings and to whom they are addressed and the date on which they are sent. While the various departments of the main office keep thoroughly in touch with the work in the field, and the material in preparation, at this point, if the work is of sufficient magnitude, it is turned over to one particular member of the contractor's force, preferably a trained engineer, whose duty it is to keep in thorough and constant touch with all the drawings and all of the correspondence. He also has access to the files of the sub-contractors, contracts, contracts for materials, the original estimate and all other information pertaining to that particular piece of work. It is then his duty to follow up their shop drawings, the submitting of the same to the architect for approval, the ordering of materials by the sub-contractors, and the progress being made through the fabricating shops and mills. This following-up process is part of his daily routine and from time to time reports are made to the superintendent in charge of the actual field work to enable him to know when the material is to be received, when the sub-contractors will have their men and material on the job, all of which enables him to shape up the field work so that certain portions of the building will be ready for certain sub-contractors at a fixed time. It is also his duty to keep track of the change orders and the changes made in the construction of the building, whether it be an addition or a subtraction. You can readily understand how necessary it is that all sub-contractors should be advised of changes, for often when they are conceived in the mind of the owner, their interference will be more far-reaching than he or anyone else anticipated.

A proper executive organization to do the field work is most important. It is far better to have too much assistance in the field than too little. First, there must be a superintendent who possesses rare abilities as an executive, who understands drawings and specifications thoroughly, who has had wide experience in building work and who has a knowledge of the different trades so as to be able to anticipate far in advance of his requirements. Above all, he should be able to create in those working under him, including the workmen employed by his department, and foremen and workmen of the different sub-contractors, an enthusiasm in their work, a desire to see it grow steadily, and to do it in the most substantial manner possible. If the work is of sufficient magnitude he should have an assistant superintendent, or possibly two or three of them, a large enough clerical force to do the timekeeping, and to keep an accurate cost record, and he should segregate the cost of the additional work which was not originally provided for. All of this work, if permitted to lag for even a day, becomes most complicated, and if not accurate, its value is entirely destroyed. In addition to this it is the duty of one of the clerks to send to the main office each day an accurate and concise report on what has been done during the day, the state of the weather, temperature, etc. As the building nears completion, work in the main office lessens, and it is usually an excellent idea to have the man in charge of the particular job in the main office to get in actual touch with the building and to assist the superintendent in picking up the loose ends and in getting each trade completed as rapidly as the progress of the building will permit. The man from the main office is thoroughly familiar with each trade, knows just what changes have been made in the work, has a splendid knowledge as to how long it will take each trade to complete its work, knows the difficulties under which each has been laboring and can finish his "following-up process" from the field more intelligently than if he were to remain at the chief office.

The Cost of Work

The cost of a piece of work is always of interest. The estimating department has access to the daily and weekly cost reports which are compiled in the accounting department, and from these they can compare and report to the proper person whether or not the work is being done each day or each week within the amount allowed for the same in the original estimate. If the work is not being done within this cost, and if the unit prices vary considerably from day to day, an investigation is at once made at the building to ascertain the reason for such fluctuations, to advise the superintendent of the discrepancy, and to see if ways and means cannot be found to bring the cost within its proper allowance—the estimate having been based on the cost of similar work under the same conditions, the proper average should not vary greatly from the amount allowed in the estimate.

The two following examples serves to illustrate the methods which were used in connection with the erection of a large manufacturing plant and a modern hotel building:

During the latter part of May, 1910, a manufacturing plant near Pittsburg covering 15 acres, was almost totally destroyed by fire. All of the buildings were brick, some with wooden trusses and slate roofs, but the greater number were constructed with steel frames and cement tile roofs. The fire in and around these steel structures was so intense, however, that most of them collapsed of their own weight, and were only a mass of twisted steel, broken cement tile, brick and mortar, all of which it became necessary to remove in order to reconstruct the plant. We first received orders to clear the site, and subsequently were instructed to proceed with the reconstruction of the buildings. Fortunately, the power plant had not been greatly damaged, and, as a large portion of the plant had to be electrically driven, we were able to get sufficient current of high voltage to use in cutting up, or, I should say, burning apart the collapsed steel frame, all of which was so badly damaged that it was loaded on cars and sold as junk.

After the site was cleared we began excavating for the new foundations, starting on the buildings which would be required first and those in which the greatest amount of machinery was to be installed. This scheme was followed so as to enable the entire plant to be completed at about the same time. It was the desire of the manufacturing company to commence manufacturing about the first of October, or earlier if possible. The key to this particular situation was to get the steel, of which there was about 4,800 tons. After consultation with the operating and executive departments of the manufacturing company, the order in which the different buildings were to be completed was decided on and the dates were fixed for the delivery of the steel for each building and were included in the schedule for the completed buildings. The structures were quite simple, similar to most of the modern factory buildings, but in order to live up to our schedule we knew we must keep continually in touch with the bridge company and see that nothing was permitted to lag or be left undone in order to make the deliveries as they promised. Our "expediter" was put in charge of the job at once and during the first month spent most of his time between the order department of the bridge company and the steel mills where the plain material was being rolled. After the last of the orders for the plain material had been sent to the rolling mills he devoted his time more particularly to the drawing room of the bridge company and reported daily just what progress was being made in designing, detailing and checking, the number of draftsmen employed, and the progress made on each building. At times it was found that the checking department was overbalanced by the detailing department and that the designing department was not turning out sufficient work to keep the detailers and the checkers busy. This was adjusted by numerous meetings between the bridge company, the executive department, the manufacturing company, and ourselves. I might say, at this point, that the principal requisites of an expediter are, a thorough knowledge of the work to be performed, a pleasant personality, and the ability to interest the people who are actually doing the work —in this case the men who made out the mill orders, the draftsmen, the different foremen in charge of the rolling mill, and the foremen in the fabricating shop. All should be made to feel that their interests are parellel and that what is good for one is good for all. As soon as the drawings for one of the buildings were completed, we saw that this work was put in the shop at once, where someone had already attended to the delivery of the plain material, and that no time was lost in fabricating and shipping the same.

At times during the preparation of the drawings it was found necessary to urge the bridge company to employ additional men in all departments. This required considerable tact and force as, naturally, the heads of the different departments, do not care to have their routine changed, or, as they express it, "meddled with." This phase of the difficulty can be overcome only when it is possible to arouse sufficient interest in that particular piece of work. When the work was started our expediter received from the rolling mills, from which he knew the steel was to be furnished, a list of their daily rollings, and we saw to it that certain materials were gotten in on dates at which the first rolling of that particular material was made. This saved considerable time, and we were able to get all of the plain material delivered before the shop drawings were entirely completed on the first building. The meetings between the heads of our department and the heads of the bridge company were most useful. Our expediter was usually on hand, and we were able to discuss the progress made since the last meeting, the condition of the work in the drafting room and in the shop, and to devise ways and means for overcoming any obstacles which had arisen, due either to lack of men or to want of materials.

The steel was erected as fast as the work was got out of the mill, fabricated, and delivered. We insisted on its being fabricated in sequence so that any materials delivered at the building could be immediately put in place. It had been previously decided at which end of the building the work would commence, and our superintendent in the field was advised of this fact and was also kept in thorough touch with the progress of the different stages of the steel. As the cars of steel were loaded and shipped out they were put in the hands of the tracing department of the manufacturing company, and our tracing department as well, and shipments were followed up until they were finally landed at the site. Our tracing department had, prior to this time, made the acquaintance of the different employees of the railroad through whom the records of the movement of the cars were to pass, as well as those who had direct charge at the transfer points. After the steel had been delivered the rest of the work was a mere question of brick, mortar, sand, gravel, cement, window frames, sash, roofing material, and sufficient workmen. Of course, there were large quantities of all these materials required and in order not to delay the work it was imperative that certain amounts of the same be delivered and put in place prior to the delivery of the steel.

The same general method was applied to the construction of the Statler Hotel, except that the work was much more complicated and required many more details. There were approximately 90 sub-contractors and material men in and around the building from almost the day it was started until its completion, and it required a great deal of patience, perseverance and hard work to get the different trades to dovetail into each other throughout, so that those who did the preparatory work would finish and leave in time to permit the finished material to be erected in a proper and substantial manner. On the Statler Hotel we found it necessary from about the first of June until a few days before the building was turned over to Mr. Statler, to insist on daily meetings of all of the sub-contractors on the work, together with the architect's representative and others interested in the building. At these daily meeting each trade was taken up separately with the principal representatives of all the other trades present. He was questioned regarding the progress of his work and was told to state whether or not he was being retarded by any of the other trades. If it was found that his work was being hampered he was made to state explicitly and in detail to what extent and how.

The advantage of having all of the sub-contractors together at one time can readily be seen, as it eliminated innumerable quarrels between the foremen of the different trades and many misunderstandings which invariably arise due to the fact that the workmen and foremen are not always capable of expressing their troubles in an intelligent manner and, when they are busy, many times do not take the trouble to express themselves at all. It was rather hard to get them to continually attend these daily meetings, as they were held in the evening after they were supposed to be through with their work. We always tried to make the meetings as pleasant and as short as possible and never permitted ill-feeling to exist between the several trades arising from the discussions at the meetings. A typewritten report of each meeting was posted on the general bulletin board so that each of the sub-contractors would have access to the same during the following day.

The following points were brought out by Mr. Stuart in the discussion of the original paper:

If we can get contracts under reasonable competition, we much prefer to do work on the lump sum basis, as the work is then entirely in our hands and whatever we can save by any unusual attention or ingenuity is ours. However, if there is a chance that the competition will not be fair, and we are after the job pretty hard, we are glad to take it on a commission basis. A great deal depends on conditions. If the contractor is thoroughly honest, and when I say "thoroughly honest" I mean if he has real conscience, then it seems to me that a commission basis is the best on which to operate from the standpoint of the owner, because he gets exactly that for which he pays.

When we take work on a commission basis, and we do a great deal of that work in Pittsburg, we make up an estimate of the actual cost of the work and tell the owner how much he is likely to expend. We do this for two reasons: One is that we do not want our organization to get into the habit of making any difference whether it is on a commission or a lump-sum basis. If you give the owner an estimate of his building, then it is everybody's purpose to keep within the estimate. The other reason is that we think it is only fair that the owner should know what the building is to cost, and we sometimes guarantee that work will not exceed a certain maximum sum.

The owners should be satisfied even though it may be a little more expensive to have the work done on a commission basis, as it saves them in other ways. For example, it gives the owner a chance to make changes and to have the work done in just the way he wishes, so as not to interfere with his business. Personally, I do not think it costs any more to do the work on a commission basis, especially if the contract covers several buildings or a long period of time. We now have three contracts on a commission basis which are yearly contracts, that is, unless they are cancelled before the close of the year they carry over to the next year.

I think the principal objection to percentage work is that the owners do not sufficiently trust the contractors. I know many honest contractors, but just as in other business there are same who are not honest.

We sometimes let some of the work to sub-contractors on a commission basis, but never when the work is of such character that it must be prepared away from the building, such as mill work, steel work, ornamental iron, etc. We have done our own plastering work, but we do not find it very advantageous, because most sub-contractors look after the work themselves as foremen. Fireproofing, painting and other trades are usually sub-let. Most people agree that to get some one who knows how to do it is worth the profit they pay to the contractor.—Engineering Contractor.

About 65 per cent of the Federal railways of Switzerland rest on steel ties and 35 per cent on wooden ties according to a recent consular report. The steel ties are in the form of inverted troughs with the ends bent down to close the troughs. The tie complete weighs about 160 lbs.

Tokio's municipal waterworks, which are reported to bring in an annual net profit of nearly $500,000, have lately received government sanction for new work, to cost $10,360,000, which will provide a system capable of supplying a population of 3,000,000.

Harbor Development Work at Vancouver, B. C.

The above illustration relates to the new causeway and sea-wall at Coal-Harbor, B. C., for the construction of which the City Council of Vancouver invited competitive plans last spring. Twenty-three designers competed but it is now learned that the plans of the City Engineer have been approved by the City Council.

Method of Finishing Concrete Alley Pavements

By John N. Edy, Asst. City Engineer, Billings, Mont.

IN 1911 and 1912 the city of Billings, Montana, improved certain alleys in the business district. Brick and wood block, at a probable cost of $3.55 and $3.35 per square yard, respectively, were considered too expensive; and it was finally decided to construct a 7½-inch concrete pavement on a 6-inch gravel base. The contract here described provided for the paving of approximately 900 linear feet of 20-foot alley, or a total of 2,000 square yards; 1,650 square yards was constructed in the fall of 1911, the remainder being placed in September, 1912. The contract price was $2.25 per square yard, which included grading but did not include the construction of inlets and catch basins.

The drainage problem was perhaps unusually complex. The alleys were 3-way or "T" alleys. At each of the three street ends permanent concrete sidewalks and alley-crossings had previously been constructed, the grades of which had been established without regard to the probability of paving the alley. A small strip of brick paving in one of the alleys, numerous area-ways and variable floor elevations, all added to the difficulty of making this adjustment. A minimum longitudinal grade of 0.3 per cent was adopted, and after careful consideration it was decided to drain all three sections of the alley to the centre of the block. At this point were placed three inlets leading into a catch basin, which, in turn, emptied into a Y-branch of the main sewer in the long alley.

The catch-basin was built of concrete, with 6-inch walls, 3 by 4 feet inside bottom dimensions, vertical walls 3 feet high. The basin is 6 feet deep and was covered with a 22 by 22 inch open c.i. grate.

A transverse slope of 0.4 feet in 10 feet was deemed ample, and it has so proved. (As will be noted in a succeeding paragraph, it was not always possible to secure just this section, on account of existing alley-crossings, the necessity of observing floor grades, etc.) The contract called for the construction of a two-course pavement; 6 inches of 1:6 gravel-concrete base, and a 1½-inch topping or wearing coat of 1:2 mortar. It is likely that this plan would have been followed throughout, had it not happened that near the completion of the first alley the contractor was unable to obtain sands. He was then permitted to finish the day's work with one course, or 7½ inches, of 1:4 concrete. This one-course pavement proved so easy to lay, and appeared to be so satisfactory, that supplementary plans were drawn providing for such construction on the remainder of the contract.

The sub-grade was shaped to conform to the cross-profile of the concrete and a sub-base of 6 inches of gravel or cinders was placed throughout.

The pavement was divided into square sections by placing a ½-inch transverse expansion joint every 20 feet. These joints were usually made by removing the wooden expansion strips and filling the opening with a tar filler. On the 1912 work, however, the expansion strips of soft wood were not removed, but were trimmed off to the surface of the pavement and left in place.

No provision was made for a longitudinal joint in the centre, nor at the sides of the alley. Where no building interfered the inside of forms was set to exact line and left in place. In case the adjoining building was on line, thin strips were set for the sole purpose of guiding the templet used.

The pavement herein described has been referred to as of reinforced concrete, when in fact the reinforcement was used only over sewer trenches. For this purpose ½-inch round steel rods were used, spaced 12 inches on centres. The length of the rods was not less than 4 feet greater than the width of the trench. In case of two parallel sewers 5 feet apart, the rods were sufficiently long to span both trenches.

After preliminary grading had been completed, finish grade for the sides was marked on buildings or on stakes. The idea was to have these side forms accurately set, enabling the transverse slope and centre grade to be secured by means of a properly shaped templet. The sub-grade and sub-base were also checked by measuring down, from the bottom of the templet, 13½ and 17½ inches, respectively.

It will readily be seen that the cross-slope of existing alley crossings might not conform to that of the pavement. In fact, not one of the six crossings in place did so conform. In some instances it was necessary to reconstruct portions of the crossing, when it was possible to make the sides and centre of the pavement parallel. In one case it was not possible to use the templet at all, a row of finish-grade stakes being set down the centre of the alley. These stakes were set uniformly 4 inches low, and upon them were placed 2 by 4's set on edge. The concrete was then rodded off on both sides of the centre and finished, after which the 2 by 4's were removed and the space filled with mortar.

Usually, the centre grade was made straight between the lowest point at inside of alley crossing and the cover of catch basin. The sides of the pavement were then run out approximately level with the sides of the crossing until the proper section was obtained, when the templet was put in use.

In order to mark permanently the side elevations along brick buildings, wire nails were driven into the mortar joints. In all cases straight grades were "shot in" by setting up at one controlling point and tilting the telescope of the level to the proper H. I. above the other.

After the sub-grade had been prepared and thoroughly rolled, the gravel or cinder base was placed, shaped, and compacted. This sub-base was sprinkled with water before the concrete was deposited. The machine-mixed (wet) concrete was conveyed to place in one-horse concrete carts. This method of handling the concrete was satisfactory, except to this extent: On account of the narrowness of the alley and the projection of area-ways and other obstructions, it was extremely difficult for the horses to turn and back into position without roughing up the gravel sub-base. In fact, where cinders were used, it was not at all unusual for the horses' hoofs to throw cinders onto the surface of the placed concrete, and for the cart wheels to completely ruin the finished grade of base. Under such circumstances it was necessary to provide an extra crew to reshape the cinder bed. However, this difficulty was not so apparent where gravel was used in the sub-base, in which case a slight sprinkling of sand kicked on the concrete caused no great damage.

The reinforcement was placed by an inspector, who also checked the grade of the pavement surface by means of the templet. The expansion strips were placed by the contractor, as located by the inspector.

While the two-course work was in progress, it was customary to place 20 lineal feet of 6-inch concrete base, which was shaped to a rough surface, and then immediately covered with the 1½-inch mortar coat. The surface was floated and brushed at the proper time. But in constructing the one-course pavement, the men spreading were forced to exercise more care, in order to work mortar to the surface and properly shape and smooth the concrete. With this type of pavement much of the success of the finisher depends upon the good work of the spreaders.

The "finish" referred to was obtained by thorough floating with a wood float and then brushing with a stiff broom.

As soon as the concrete was sufficiently hardened it was covered with a layer of earth or sand, and kept moist for a period of five days. In good weather the pavement was thrown open to the public after the expiration of five to seven days. Pit-run bank gravel was used throughout, no river gravel being permitted in the concrete.

The pavement described in this paper has been in use nearly three years; and while that is a very short time as compared with the probable useful life of the improvement, it is nevertheless possible to form certain conclusions as regards its apparent serviceability. In the first place, although the concrete has passed through extreme changes in temperature, no expansion or contraction cracks have developed, and although subjected to a very heavy traffic, there appears no appreciable evidence of wear. Within a month after some of this pavement was placed it was necessary to cut an opening to repair a leaky heating main. This opening was filled with gravel and permitted to remain until spring, when the concrete patch was laid. The new concrete has bonded perfectly to the old, it being difficult to detect the patch; there has been no ravelling whatever. During the past summer numerous openings were made to permit the laying of gas mains, and these patches are also hard to locate.

The concrete pavement is, of course, more noisy than the wood block, but not so noisy as the pitch-filled brick. The writer is advised by the street commissioner that the paved alleys are very easily cleaned.

The drainage system is giving good satisfaction, except that, in the writer's opinion, the minimum longitudinal grade had better be 0.5 instead of 0.3 per cent. The transverse slope might be reduced to 0.25 or 0.3 feet in 10, although there is no apparent reason for doing this. It would be possible, the writer believes, to reduce the thickness of sub-base to 4 inches, and of the concrete to 6½ or 7 inches, without affecting the usefulness of the pavement. The writer favors the one-course work, mixed wet in the proportion of 1:2:4, or 1:4 or 1:4½ (local) pit-run gravel. There appears to be no need for a longitudinal expansion joint.

The contractors' equipment consisted of one 14-foot mixer with steam power; two single-horse carts for conveying; wheelbarrows, etc.

The mixer was loaded from barrows, the distance from gravel pile to mixer being 40 to 50 feet. Cement was delivered to the mixer platform by team from the sheds.

Maximum haul for concrete was approximately 315 feet; minimum haul, 20 feet.

The earth sub-grade was rolled by a gasoline traction engine, which gave better service than a roller for the reason that areaways, manholes, poles, etc., rendered the use of the roller impracticable.

Construction Costs Less in Winter

INVESTIGATIONS by the Aberthaw Construction Company, Boston, in connection with the cost of component parts of the average reinforced concrete building, indicate that work in the winter season costs less than summer work. While it is not possible to put a definite figure upon the reduction in cost, yet some of the parts of the building lend themselves to this treatment and an estimate can be made for other items.

In addition to the direct saving in materials is the saving, which cannot be definitely fixed, due to the ease of securing materials promptly, thus avoiding delays and the incidental heavy overhead. Another factor arises from the ability of the contractor at the present time to put some of his picked men into the organization, thus getting better results than if he were pressed for men to finish work under way. In addition, the average contractor can give more direct personal attention in winter than at times when business is abundant. The three items just mentioned have been estimated at about three per cent. on the total cost of the building. If we add to this possibly 4½ per cent. or 5 per cent., represented by a reduction in the cost of materials, this makes a total saving of approximately 7½ per cent., as compared with last summer, and with conditions which may prevail again before many months are passed.

Costs and Other Features of Surfacing Track

IN doing any kind of track work with common laborers, the organization or distribution of the men is a matter requiring careful consideration and close attention, for it is the proper disposal of men which more than any other one thing effects the amount and quality of work done. It has been said with truth that a gang of poor workers well organized is a better gang and will accomplish more than will a gang of good workers poorly organized. Time and confusion are saved by assigning each man his task, and requiring him to remain as placed until otherwise ordered.

The value of organization is not fully appreciated by all track men, and is badly misunderstood as respects track work by those unfamiliar with the subject. The word not only designates placing men so that they will work harmoniously and advantageously, but it implies also that each man shall be placed at the work for which he is best fitted. One can readily see that this result cannot be immediately attained, but it is the idea aimed at; and not only must the physical makeup of the man be measured, but a man's disposition, age, willingness, natural skill, and familiarity with the work must also be considered. A man who shows a disposition to lag will many times hold his own against a more willing workman if the work is arranged on a competitive basis. For instance, if a laggard is placed where he must rehandle a certain amount of material which is being passed to him by another, he will, in many cases, do enough work to keep from being "snowed under."

The amount of work accomplished by the individual is very closely related to gang organization. The best men should be put in the lead, and wherever possible the work should be arranged so that each man will have to do an equal share with the head man, or else fall behind and be easily detected. It is characteristic of the laborer experienced in track work, that he is loth to admit the superiority of another man. When such a man is placed so that the amount of work he accomplishes is directly measured by the amount some other man does, he will generally do his share.

The greatest amount of work will be obtained from most gangs by treating them considerately, and this policy makes the work more pleasant for both laborer and foreman. "Driving" men is being done away with to a great extent, as it is becoming difficult to keep laborers when such a policy is pursued.

The idea that men should be treated considerately does not mean that discipline should be sacrificed. The foreman's discipline should be strictly maintained under all circumstances. He should personally see to it that each of his orders is obeyed. In case an assistant foreman is employed and the gang is not separated, all orders should in general be given through the assistant foreman. This will to a great extent prevent conflicting orders being given to one man. The assistant should be backed up by the foreman in all cases in order to maintain his authority.

In order to provide maximum and easy supervision, the men should be kept as close together as is possible, without interfering with each other. The scattered condition of a gang may be due to poor organization or to irregularities occurring in the work, and a foreman will show his ingenuity in arranging the work and the laborers so that the gang is kept compact.

The American Railway Engineering Association has specified that before ballasting a new track "all dirt above the bottom of the ties shall be removed." This is a very necessary procedure, for after the track has been ballasted, the part of the sub-grade directly under the track will be compressed and will settle, and this action will continue possibly for a number of months. So that even if the top of the grade is made level before initial ballasting, the top of the dirt sug-grade will gradually assume a longitudinal trough of ditch-like surface. The depth of this trough has actually been found to be from 8 to 10 ins. on a grade in Illinois, from which the ballast was removed.

Ballast of nearly every kind—gravel, cinders, crushed stone—is much more pervious to water than the dirt which is in the embankment. Rain water falling on these ballasts will soon penetrate to the dirt sub-grade. If there is a basin beneath the ballast, water will be retained on top of the sub-grade. If the original depressions made by the ties are left in the sub-grade, the greatest accumulation of water (which will cause softening of the track foundation) is immediately beneath the tie where the greatest pressure comes and where the greatest resistance should be. The softening of the grade will tend to allow the ballast and the track to settle further and thus make the condition still worse. All water which collects in this manner must soak through the dirt of the sub-grade till it finally finds an outlet. If, however, the surface of the sub-grade were higher in the middle than on the shoulders or even if it were level, the water which penetrated the ballast would find a natural outlet along the top of the more impervious dirt of the sub-grade.

The usual width of roadbed for single track main line is from 18 to 20 ft. and for double track from 30 to 33 ft. For double track therefore, it is even more imperative that the surface of the sub-grade be level, or better yet, slope toward the outside. The American Railway Engineering Association specifies three widths of roadbed, 14, 16 and 20 ft. for single track roadbeds, but common practice seldom allows anything less than 16 ft. The distance from the end of the tie to the edge of a 16-ft. roadbed would be 4 ft.; to the edge of a 20-ft. roadbed would be 6 ft. A specification for a sub-grade should, I believe, require that the middle 10 ft. of the grade be 6 or 8 ins. higher than the shoulder. If the width were made less than 10 ft., the difficulty of laying track would be unduly increased.

Height of Raise, Tamping, Etc.

Surfacing new track differs essentially from raising track on an old bed. Track must be raised high, and because of great inequalities in the solidity of the roadbed, which will cause unequal settling, it is not quite so important that the "top" or surface of the track should be the best obtainable.

Giving the new track a high lift is especially essential if it is down and the mud shows occasionally between the ties. Even the second lift on new truck will not be of much account if it is only 2 or 3 ins., unless the sub-grade is of unusually good quality. Of course care must always be taken not to raise the track so high that sun kinks will occur. With heavy, coarse gravel, there is not as much danger of sun kinks as with fine gravel. Good judgment must be used in putting up the track only so high that the ballast dressed in will be sufficient to hold it in surface and line.

The rule has been generally accepted that tie centres should not be tamped beyond about 15 ins. from the rail, in gravel ballast, the idea being to prevent what is called centre bound track. This rule is undoubtedly a good one in regular maintenance work. There is danger that the centres will be tamped up too stiff, causing poor riding track and broken ties. On construction work, however, full centre tamping is usually advisable. When surfacing is done by contract there is practically no danger of getting the centres too well tamped, and where the lift is high, and the grade new, the settling of the roadbed will be the most serious feature and will entirely overshadow the effect caused by too stiff centre tamping.

While most track men are entirely familiar with surfacing track on an old bed, there are some differences in surfacing track on a new bed which should be brought out, together with a suggested organization.

Distribution of Men and Work Performed

The gang should be organized somewhat as follows, varying the number of men filling in and tamping track as conditions require:

1 spot board man
2 jack hole diggers
6 jack men
4 jack tampers
4 men filling in for jack tampers
1 level board man
1 hammer man
8 men filling ends
16 men tamping ends
8 men filling centres
12 men tamping centres

The spot board man sets up the board from sights made by the foreman or competent assistant, unless sufficient ballast is unloaded to make a complete raise to grade stakes. Two spot boards should be used, and the man sets one spot board in advance and has it ready so there is no delay of the jack men.

Of the three jack men on each jack, two carry the jack ahead and the third carries the jack board ahead (preferably a base plate with a wire handle), and places it in the next jack hole. Extra jack boards and a man to do nothing but place these in advance of the jack men, are sometimes advantageous and increase the amount of work done.

The level man levels up the track and also sets the spot board block back for the foreman to sight across, unless one side of the level is trimmed down to the correct height for a spot board block and is used for that purpose. After the jacks are let off, the hammer man knocks down track by hammering the ties if necessary. He should also carry a spot board block so that the jack men will not have to wait for blocks while a joint is being knocked down.

It is perhaps needless to say that the men around the jacks should be the best men, as the amount of work accomplished depends so greatly upon them.

The foreman should sight from about the same distance back of his jacks each time, and should raise both centres and joints with the spot. It is a waste of time and energy for the jack men to raise the joints first and then double back and raise the centres.

The tampers should be organized to tamp the track in the following manner; if there are four pairs of tampers on the ends each side, have the head pair tamp every fourth tie, the next pair tamp the tie behind that, etc. The centre tampers should follow a similar system. Besides keeping the men at work close together without interference, this method accomplishes two other very desirable conditions, viz.: it makes it possible to get more work out of men who would soldier under the old methods; and more important still, the track as a whole is tamped in a more uniform manner. Under the old method where each pair of tampers was assigned a rail or half rail length, the sections tamped by the better tampers stood up better than the rest. Where the good tamping is mixed with the poor the whole track is more likely to settle uniformly.

A gang of 60 or more men should have a first class general or head foreman, and at least two assistants, one of whom should "follow the jacks," that is, sight the blocks for the actual raising of track; the other should have charge of finishing and lining after track is raised. The general foreman should personally see to all matters pertaining to organization, and to the general conduct of the work. And it will fall to him to see that the tamping is properly done, as his assistants will be kept busy with their duties and unable to look after this very important item. The placing of men is likely to need changing several times every day, for conditions change as the work moves along. For instance, the uneven distribution of ballast may make it necessary to make a change in the line-up. If gravel is unloaded too heavily, which is often the case, the number of jack hole diggers will have to be increased, while the "swampers," or men filling in can be reduced; if the unloading is too light, the swampers are not likely to be able to keep ahead of the tampers. All these things and many others are matters for the foreman to adjust. Highway crossings also force a readjustment of the force, as they have to be planked and graded as soon as they are crossed. The foreman who is "onto" his job can generally spot some man in the gang, usually some old man who has followed track work for years as a means of getting his living and whiskey, who, while unable to keep pace with the younger men at tamping, is worth his wages to look after such jobs as fixing up crossings, and other items like that. The foreman will find that there is enough to keep him busy without having to stand over a crossing that is being put in shape, and will appreciate an old man like this.

The foregoing applies alike to either contract work, or work done by the company forces. Contractors nearly always see the economy of having ample supervision, while on the contrary railway companies are usually averse to having enough assistant foremen to properly look after the work. In these days, the laborers being nearly all foreigners who do not understand the English language, it is absolutely necessary to have more supervision than is usually accorded by the railways if the work done is to be up to the standard it should be.

Costs

The costs given below are in two parts. In the first portion, the rate paid laborers was $2 per day, the work being done in the cool, early spring months, from April 17, to May 28, 1913. The costs in the second part represent totals where the ordinary rate for laborers was $2.25 per day, work done in the summer months from June 7 to October 3, 1913.

The total cost chargeable to track raising during the early period was $5,064 for raising 60,100 ft. of track, average raise 6 ins., with laborers at $2 per day. This total figures out at $445 per mile, including lining and dressing up the track to standard.

The total costs chargeable to track raising during the period with laborers at $2.25 per day, was $7,850 for 74,400 ft., average raise 6 ins., which figures out $621 per mile. This figure includes dressing track to standard.

The average raise was 6 ins. Ballast was good clean gravel, but was too fine to make the best ballast.

It was easily and quickly tamped, however. The track was shovel-tamped only, and was tamped clear across ties, as the softness of the grade precluded the possibility of centre bound track.

Especial emphasis should be given these costs as they give comparison between:

(1) Costs of doing work with $2 labor and $2.25 labor.

(2) Unit costs in the early spring and unit costs in the hot summer months.

(3) The effect on costs of breaking up and reorganizing a gang.

The first gang struck for a raise of wages which was refused. Then new men could not be obtained at $2 per day, so it was necessary to offer $2.25 per day. A very poor class of labor was obtained for the second gang. This was due to the great demand for laborers in the summer months, and the resulting scarcity of good laborers. The gang hired in the early spring was American labor, while many foreigners were included in the second gang.

The difference in quality of laborers obtained on this work bears out very strongly the contention of track men that a much better class of labor can be obtained in the spring than in the summer. The cool weather also has a very marked effect on the costs, as shown in this work.

The effect of breaking in or organizing a new gang is not generally realized by many railway men and contractors. The costs were so much greater that the contractor in this case would have been justified in raising the wages of the old gang to $2.50 or $2.75. Such occurences are all too frequent. An experienced and reliable man is refused a raise, and then it is found necessary to offer a considerable higher salary to obtain even a green man to do the work, frequently one who cannot even approach the efficiency of the former man.

It is safe to assume that the difference in efficiency between the better men obtained in the spring and those obtained in the summer will be at least 25 per cent. The work on the above was 42 per cent cheaper in the spring, but the cool weather was undoubtedly responsible for part of this. It is fair to assume, however, that the old gang would have continued with at least as high efficiency as they had attained, and on this basis the last 12 miles put up at $621 per mile represented a loss of $2,032.

The costs, especially during the early spring, are very low, much below the average of surfacing by railway forces. There are two reasons for this low cost—ample supervision and quality labor. Few railways would allow three assistants and one general foreman at a total of $15.50 per day to supervise a gang averaging about 70 men. The writer's experience would indicate that the usual supervision would consist of one foreman and one assistant, totalling about $6.50 per day, for this size railway company gang. And with this inadequate supervision they pay 25 cts. to $1 less per day for laborers, and get a class of men which is really in greater need of supervision.

There are two other features that attention should be drawn to: (1) The same foreman handled both gangs; (2) Costs in each case include the extra cost of organizing, each gang being made up from new shipments of men.

Comparison of Costs

The conclusions to be deducted from the above are that it is profitable to:

(1) Allow ample supervision—say one assistant foreman to each 25 men.

(2) Hire men as early as possible in the spring.

(3) Pay quality prices and obtain quality labor.

(4) Push the work vigorously in the cool months.

(5) Use every means to retain an experienced and organized gang—it will pay well.

(6) Raise the wages of old men rather than hire inexperienced, incompetent men.

Dual System of Water Supply and Distribution

The dual system of water supply and distribution has frequently been discussed in technical literature. Whenever the subject has been brought up the more or less obvious disadvantages of the system have been pointed out. The subject is an attractive one apparently, however, and waterworks men show a disposition to revert to it from time to time in their discussions before the several waterworks associations. The latest discussion of the subject was by Mr. Henry C. Hodgkins, of Syracuse, N.Y., in his paper before the recent annual convention of the American Water Works Association. The following matter is abstracted from his paper by Engineering and Contracting.

The daily average consumption per capita for cities in this country will run from 100 to as high as 200 gals. Very few large places will average less than 100 gals. The maximum per capita consumption will run from two to four times the average. The average daily consumption per capita for domestic purposes will amount to from 25 to 30 per cent. of the total average, and the amount required for culinary and drinking purposes will amount to from 3 to 5 per cent. of the total. The amount of potable water thus required is very nearly a constant quantity from day to day. Filtration plants cost from 12 to 20 per cent. of the total cost of the remaining portion of the waterworks in the case of mechanical filters and 20 to 30 per cent. in the case of slow sand filters. In Pittsburg, the estimated cost was 30 per cent. and in Toronto 20 per cent. of the previous cost of the works.

In a city of 100,000 Mr. Leonard Metcalf estimates the cost of that portion of a distribution system due to domestic consumption at 21 per cent., that due to industrial consumption at 32 per cent. and that due to fire protection at 47 per cent. If the division is carried farther that portion due to culinary and drinking purposes would be about 4 per cent.

If the distribution system could be separated into distinct systems and at the above proportionate costs the problem of dual systems would be easy. But such is not the case. The cost of a dual system in terms for a complete system would vary widely, but as a general proposition I think it a fair statement that a separate system to supply the inhabitants of a city with potable water would cost from 25 to 30 per cent. of the distribution system as generally constructed. In other words, that the cost of the dual system would be from 70 to 150 per cent. of the cost of the filtration plant, varying widely according to conditions and according to which system of filtration is used.

There is a wide range in the cost of filtering water. Making due allowance for maintenance of plant, interest and depreciation, the cost would probably fall between 1 cent and 1.5 cents per 1,000 gals. Assuming a cost of 1.2 cents per 1,000 gals., the cost of filtering

1,000,000 gals. per day would be	$12.00
40,000 gals. per day would be	.48
Difference per day due to filtration	$11.52

That is, if instead of filtering all of the water only the portion furnished through the dual system was filtered, the saving in the cost of filtration would amount to $11.52 per million. From this would have to be deducted the interest, depreciation and maintenance of the dual system which in a medium sized city would require not to exceed half of this saving, leaving the remainder for the additional cost of administration and saving to the department.

The pure water should sell at a much higher rate than the raw water for two reasons: first, to provide ample revenue to cover all charges due to the dual system, including service pipes and meters; and second, the price should be high enough to prevent the use of pure water for other purposes than those intended.

These figures are merely illustrative, but they are sufficient to show that the dual system is not impossible from a cost point of view, but that it is entirely feasible and in many instances the solutions of a very difficult situation.

It is not claimed that the dual system should be universally adopted, but in places where there is a supply of naturally pure water sufficient to meet the culinary and drinking requirements, it is urged that it be supplied through a separate system, leaving the larger requirements to be furnished from the nearest and cheapest source of reasonably clean water.

There are many instances where towns have outgrown their water supply. The present supply being excellent in quality, but insufficient in quantity. Just such an instance exists in the writer's practice. The demands have increased beyond the supply and the capacity of the distribution mains. It has been recommended and considered with favor, that a duplicate system covering nearly half of the town be installed, furnishing a water more suitable for manufacturing purposes, but not fit for drinking. The original distribution to supply all of the needs of a portion of the residential section from the original source, and with the smaller mains extended to all parts of the town, supplying all the inhabitants with the excellent drinking water, it being the expectation that as the city grows the dual system would be extended until the entire city is covered.

Because the industrial growth of the town has caused a demand beyond the capacity of the supply, but which is still sufficient for all house supplies for even a much larger town, should the best of nature's supplies be discarded and replaced by a filtered supply?

The difficulties of supplying the ever increasing demand with a potable water are such that all naturally pure waters should be conserved, and it would seem that it is time that the scientific planning of dual systems should be commenced. It is not the purpose of this paper to criticise work that has been done or that is under way; but to emphasize a new departure in waterworks construction and management. There is no reason why the bottled purveyors should have the best of the business. Pure water, like other food products, should be conserved and delivered in the best possible manner.

The great argument against the dual supply has been the difficulty of controlling its use. It has been argued that poor people would use the cheaper water, and that many, especially new arrivals in the city, from ignorance would use the contaminated water. Every precaution should, of course, be taken to prevent the wrong use of either water. The drinking faucets should be of one handsome ornamental design, properly labelled. All other faucets should be of the same and an entirely different and distinctive design. Greater care and inspection of all fixtures would be necessary, which would certainly be progress in the right direction.

In discussing the paper, Mr. Frank C. Kimball related the classic Lawrence, Mass., case as an argument against the dual system. In that case there was a filtered water supply for drinking and culinary purposes. The polluted river water was piped through the mills for ordinary use in washing and similar purposes. The pipes carrying the polluted water were of one uniform color and were labelled. A penalty was imposed on the use of this water for drinking. Despite these precautions the mill operatives drew water from the polluted supply wherever it was more convenient to do so than to draw on the pure supply. This resulted in considerable sickness and several deaths and the polluted supply was abandoned by the mill owners.

Mr. F. W. Cappelen, city engineer of Minneapolis, said that it is the duty of every city to furnish a pure water supply to all its inhabitants. The quality of this supply must be so good that a child can drink it; so that anyone can open a faucet anywhere and be safe in doing so. Every inhabitant must be protected against his ignorance or carelessness. This cannot be done with a dual system.

Specifications for Road Tars

Directions and specifications for the tar treatment of roads issued by the Road Board of Great Britain state that for tar No. 1 (suitable for the surface tarring of roads) the distillate between 170 deg. and 270 deg. C., or 338 deg and 18 deg F. (middle oils), shall remain clear and free from solid matter(crystals of naphthalene, etc.) when maintained at a temperature of 30 deg C. for half an hour. This requirement, however, may be waived in the case of tar supplied direct from gasworks; but tar from which the naphthalene has been extracted is preferable to tar containing much naphthalene. The tar must contain not less than 12 per cent and not more than 21 per cent by weight of free carbon. The free carbon is to be determined by complete extraction with benzol and carbon bisulphide of the bituminous matter from a weighed portion of the tar. The residue left is to be taken as free carbon. Specifications for tar No. 2 (suitable for making tar macadam, and for surface tarring in very hot weather, when the road crust is exceptionally dry) stipulate that the tar may contain not more than 25 per cent of its volume of the tar (or distillates or pitch therefrom) produced in the manufacture of carburetted water gas. The free carbon limit, which formerly was 18 per cent of the weight of the tar, has been altered to not less than 12 per cent and not more than 22 per cent by weight. Prepared pitch from tar distilleries must contain not less than 16 per cent and not more than 28 per cent by weight of free carbon; and commercial soft pitch not less than 18 per cent and not more than 31 per cent. In the latter case the pitch may contain not more than 25 per cent of pitch (formerly 10 per cent) derived from tar produced in the manufacture of carburetted water gas for both tar and tar oils.

The new third lock for the canal at Sault Ste. Marie, Mich., is nearing completion and is expected to be open for navigation within a month. This lock will be the longest in the world, its dimensions being: length, 1,350 ft.; width, 80 ft., and depth sufficient for boats of 24 ft. draft.

Canadian Contractors and Their Work

Mr. S. M. Brookfield, the Halifax Contractor

ONE of the most conspicuous figures in the contracting field of the Maritime Provinces is Samuel Manners Brookfield, President of the general contracting firm of S. M. Brookfield, Limited, Halifax. Mr. Brookfield was born in Yorkshire, Eng., in 1847. His father was John Brookfield, C.E., a war department contractor for some twenty years. The son, Samuel, commenced business with his father as purchasing agent, and was identified with him in the construction of the fortifications at Halifax, the St. John Military Hospital and the Provincial Buildings at Halifax. Upon the death of the father, in 1870, the son took over the business. Following the fire at St. John, N.B., in 1877, Mr. S. M. Brookfield built the Bank of Nova Scotia and other structures. He also carried out much important work at St. Johns, Newfoundland, after the fire which occurred there in 1894. At Halifax he carried out an expeditious contract in building the Academy of Music in the remarkable time of twenty weeks. He built the Sugar Refineries at Richmond and Dartmouth and the cotton factories at Halifax, and he was associated with the well-known Pearson contracting firm, of London, Eng., in the construction of the Halifax graving dock. In 1906 the business was turned into a limited company, of which Mr. Brookfield was made president. Many noteworthy undertakings have been carried out by the new firm, notably All Saints' Cathedral, the new Y. M. C. A., and the North-West Arms Memorial Tower, all at Halifax, and the new Sugar Refineries at Woodside. Mr. Brookfield has many interests outside of his own particular business, but he has been particularly prominent in shipping circles. He was President of the Canada & Newfoundland Steamships Company, whose business was conducted successfully for six years and then sold to the Furness Steamship Company. As Manager of the Halifax Graving Dock Company he was identified with the formation of a salvage firm which released a number of large steamers, including the C. P. R. "Mount Royal" (10,000 tons), and gave a great deal of work to Halifax. For some time Mr. Brookfield sat on the aldermanic bench of his city, and he was also a member of the local School Board.

Mr. S. M. Brookfield, Contractor, Halifax, N. S.

Garbage Collection and Disposal at Vancouver

Interesting details concerning methods of garbage collection and disposal in operation at Vancouver, B.C., are contained in a letter contributed by Mr. B. Wylie, of Vancouver, to Municipal Engineering. Mr. Wylie, who was for a number of years in charge of the garbage department at Vancouver, contributed the information in response to a request for particulars regarding the collection and disposal of municipal wastes. He writes:

The city of Vancouver has a population of 120,000 people and its area is about fifteen square miles. The layout of the city is such that there is an alley in almost every block. This, of course, makes the collection of refuse much cheaper than where everything has to be carried out to the front.

The city owns and operates all its equipment both for the collection and the disposal of all the city wastes.

Some years ago this work was being done by the contract system, but owing to the unsatisfactory service being rendered to the citizens, the city council of that time very wisely put an end to the contract system, and placed the whole system under civic control. The city purchased the equipment which was owned by the contractor, for which they paid him a fair valuation, and by so doing acted fairly and justly with him. Under the contract system there was continual trouble between the contractor and the people to whom he was rendering the service. This might have been no fault of the contractor. The fault lay more with the city for having let the work out by contract, when they themselves should have kept it under their own control.

The city has now over 70 vehicles in the garbage department, consisting of single-horse carts, double teams, and large motor trucks. The single carts are used mostly in collecting from the residential districts of the city, the large wagons in the collection of ashes and such like, while the motor trucks are used in cleaning up the down-town district where the garbage and refuse is heavy.

The garbage is collected once a week in the residential districts, and every day from hotels and the business section of the city. The department will go to any part of the city when called upon, but the party ordering the vehicle has to pay for the charge, which is governed by by-law. From the residential section of the city there is no limit placed upon the amount of garbage that the city will remove, the only restrictions being, that the refuse must be placed in galvanized receptacles which must be kept covered and free from liquids. The garbage is removed free of cost from all residences and the cost is taken from the general revenue of the city. All business houses and such like have to pay the department for any services rendered, according to the amount of work performed.

This city has an inspector in each district. These districts are subdivided into beats so that each teamster has his own beat to look after, and should any complaint come into the office, the inspector can at once find out who is at fault, as he knows the number of the man working on the beat at the time the complaint came in. The inspectors report daily to the head foreman, who has charge of the whole city under the superintendent. These reports are kept on file in the office for future reference.

This city has two destructors in which all the wastes of the city are destroyed. The destructors have given good satisfaction and do their work effectively and without any nuisance. Both the destructors have steam boilers, but little or no use is made of the steam which is generated, the only use being the heating of the buildings and office around the plants. The calorific value of the garbage being low, would necessitate the purchasing of fuel in order to keep a steady supply of steam. With coal at $7 per ton this was considered out of the question.

MAINLY CONSTRUCTIONAL

EAST and WEST — FROM COAST to COAST

EASTERN CANADA

Two head gates at the entrance to the Welland Canal are reported to have been torn away by a collision on the part of a freight steamer entering the waterway on July 27.

The Education Commissioners of Montreal have had plans prepared by architects Doucet & Morissette, for the construction of a girls' school at an estimated cost of $200,000.

Good progress has been made so far on the construction of the new filtration plant at Montreal, the cost of which will approximate $160,000. The general contractors, F. J. Jago & Company, have the foundations in.

At Montreal, Que., plans are in progress preparatory to the construction of a stadium on Pine avenue, for McGill University, at an estimated expenditure of $100,000. Messrs. Nobbs & Hyde, Montreal, are the architects.

Tenders are to be called immediately by the Dominion Government for the construction of a new lock on the Trent Canal at Bobcaygeon. The site for the structure has already been purchased by the Department of Railways and Canals.

An apartment house is to be erected shortly on St. Catherine and Glen streets, Westmount, Que., at an estimated outlay of $275,000. Messrs. Audit & Cherbonneau are the architects of the structure, which will be erected for O. Lamoreaux.

A $200,000 by-law for permanent street improvements and the construction of sewers was voted on a few days ago by the ratepayers of Sherbrooke, Que. The by-law was defeated. The result is said to have given rise to a good deal of controversy.

The township council of Barton, Ont., have in contemplation the construction of a sewerage and water works system likely to involve an outlay of $500,000. The work, if carried out, will likely be in the hands of Mr. J. B. Nicholson, Township Engineer.

The firm of Wilson, Townsend & Saunders, engineers and contractors, Toronto, have secured the contract, at about $35,000, for the masonry and concrete work in connection with the Strachan avenue bridge, Toronto. The retaining walls will be 225 ft. long and there will be two heavy masonry abutments.

C. E. Deakin, Limited, Montreal, have obtained a contract for the construction of a Catholic orphanage on Decarie avenue, Notre Dame de Grace, plans for which have been drawn by Mr. Alphonse Piche, Montreal. The building will be of stone and brick, with concrete floors, and is estimated to cost $175,000.

Hamilton City Council are extending the city's sewerage system in the east end at an expenditure of approximately $175,000. The scheme will include 2,400 ft. of 30-in. sewer to the disposal works; 3,100 ft. of 4 ft. 6 in. sewer on Burlington street; and a new pumping station on Gage avenue at a cost of about $53,000.

Four new brick kilns, which are under construction at the new plant of the Mount McKay Products Company, are almost completed by the contractor, Mr. Claude Smith. The plant is at present turning out about 20,000 bricks a day, and when running at full capacity, according to Mr. Smith, the daily output will be increased to 70,000 bricks in addition to products of terra cotta and tile.

The construction of a breakwater extension in front of the Port Arthur harbor is well under way. The breakwater will be 2,500 feet long and 30 feet wide, with a block, 40 feet wide, at the end for the accommodation of a lighthouse. The extension consists of twenty-five cribs, 100 ft. in length. Piles have already been driven for fifteen cribs.

Four sets of plans for the projected high-level bridge at St. Catharines, Ont., have been supplied by Mr. N. S. Sprague, consulting engineer, of Pittsburgh. The plans, which embrace four different designs, are under consideration by the Bridge Committee of the Council, who are expected to take definite action in the matter at an early date.

Building returns for the past half year in Montreal show that the number of permits taken out is greater for the first six months of the present year than in the corresponding period in 1913. This is due to the fact that more dwellings and buildings of the smaller type are in course of construction this year. For 1914, from January to June 30, the estimated value of new buildings was $8,521,910, against $9,942,286 in the same period in 1913.

The Toronto Board of Control has referred the tenders for the construction of a Registry office on Elizabeth street, Toronto, at an estimated cost of $400,000, to Property Commissioner Chisholm, the City Architect, and Mr. C. S. Cobb, architect, for a report. The contracting firms tendering for the general contract are Fred Holmes & Son, Peter Lyall Construction Company, Norcrosse Brothers, and John H. Parker, Canada, Limited.

In a letter to the Mayor of Ottawa, Messrs. Hazen & Whipple, engineers in charge of the preparation of plans for the Ottawa River water supply, state that these will be ready for submitting to the Provincial Board of Health for approval by the middle of August. The plans upon which the engineers are working are for the construction of a purification plant on the site designated by the City Engineer, Mr. A. Currie, in a recent report.

A press report states that the Stanley Works, of New Britain, Conn., said to be the largest steel good manufacturers in the world, have acquired a large interest in the Canada Steel Goods Company, of Hamilton, Ont. The carrying out of these arrangements will probably be followed by the location of a big plant in Hamilton for the firm's Canadian and export business. The plans for the extension call for the erection of large rolling mills and the installation of new machinery.

The five-million-dollar good roads scheme promoted by the Ontario Government is having a marked influence on the highways of new Ontario, judging by a report made a few days ago by Roads Commissioner Whitsun, of the Provincial Government, upon his return from a tour of inspection of the northern part of the province. The new highway between Rainy Lake and the mouth of the Rainy River is progressing rapidly. The Port Arthur and Fort William road is being stoned and gravelled and new highways cut into the Pigeon River country, connecting Fort William with the Minnesota State road, which latter leads to Duluth and is one hundred miles long. The trunk road between

North Bay and Mattawan, a distance of about fifty miles, is completed. The eighty miles of road from Sault Ste. Marie to Algoma Mills will be open for traffic this season and the trunk road from Sydney to North Bay will be completed within a year.

An extension to the elevator capacity of Montreal is in contemplation by the Harbor Board, the purpose being to construct an addition to their No. 1 elevator, which will supplement the present capacity by a million and a half bushels. The elevator already has a capacity of two and a half million bushels, so that when the new addition is completed it will be one of the largest elevators on the continent. The cost of this extension is expected to approximate $750,000. It will be of the same type as the extension at the east side of the original No. 1, with concrete tanks. The plans are being submitted to the Department at Ottawa and when approved tenders for the work will be called in order to have the new elevator completed by September.

The girder concrete bridge over the Yarmaska River, for the Montreal and Southern Counties Railway, has just been completed by the contractors, Messrs. Ross & McCombe. There are two massive piers and two abutments, each of the three spans being eighty feet in length. As the river at St. Cesaire, where the new bridge is located, contains a quick-sand bottom the piers are to be constructed on piles, of which eighty, having a length of from thirty-five to forty feet, were sunk under each of the four substructures. About two thousand yards of concrete was used for the piers and one thousand cubic yards of rip rap was put into the foundations. The Hamilton Bridge Company were the contractors for the girders of the bridge, which will cost in the vicinity of $75,000.

Dietrich, Limited, Montreal, have obtained a contract for constructing a drainage system at Drummondville, P.Q., at a cost of $32,000. This will be a combination system for sewage and water, which will have an outlet in the St. Francis River. At present there is a system on the lower level of the town, and the work to be carried out will apply to the upper level. The drains will be of tile up to 27 in., and above that of concrete. A large amount of roadway is also to be constructed. The same firm are carrying out water and drainage systems at Parent, Fitzpatrick and Doucet, three divisional points on the Transcontinental Railway. Dietrich, Limited, have also been awarded the contract for a street lighting and conduit system at Lachine, P.Q., for which Messrs. Dupont, Roy and Baudouin, Montreal, are the engineers.

Work on the construction of the new Union Station for Toronto has commenced. Preliminary work includes the erection of a board fence around the Front, Bay and Yonge street sides of the site and excavation has been started. The foundation for the erection of the field office, at the corner of Bay and Front streets, is in course of excavation. This temporary building is intended for the accommodation of engineers, architects, and office staff. On behalf of the Board of Architects, Mr. H. Ferguson, who had charge of the building of the Chateau Frontenac, Quebec, and the Grand Trunk depot in Ottawa, will supervise the work. The P. Lyall Construction Company, who are the general contractors for the construction of the station, will be represented by Mr. Griffith. The cost of the buildings will be approximately $2,000,000.

Messrs. George Anderson & Company, Limited, of Carnoustie, Scotland, the parent firm of George Anderson & Company of Canada, Limited, Montreal, have just been successful in securing two very large contracts. The first for eleven wharf cranes for the Port Commissioners of Calcutta, was secured in the face of strong competition with all the leading crane makers of Great Britain and Europe. The firm, who have supplied cranes of all types all over the world, send only the ironwork to foreign countries, the lumber being supplied at the site, thus reducing the freight charges to a minimum. The second contract, which was also secured, in the face of very strenuous competition, is for eight large gas engines and suction gas plants for the Hirosima irrigation scheme in Japan. These engines are designed for continuous running on a very small quantity of fuel which, in this case, is charcoal.

WESTERN CANADA

Sketch plans are in preparation by the architect, Mr. J. H. G. Russell, in connection with the projected construction of a Children's Home at Tuxedo Park, Winnipeg, at an estimated cost of **$300,000.**

The Board of City Commissioners of Edmonton has created a new municipal position, that of General Inspector over every department of city work. The first inspector to be appointed is Mr. A. J. McLean, at a salary of $3,000 a year.

Work on the construction of a reservoir for the City of Regina has commenced and a large gang of men is employed on the excavation. The new reservoir, the capacity of which will be five million gallons, will be located on a site to the north-east of the old power house.

A report from Ottawa conveys the information that the United States government, which is building the Alaska railroad at a cost of $35,000,000, will extend the line from the Yukon territory into northern and central British Columbia, connecting with the main line of the Grand Trunk Pacific.

At Regina, Sask., the R. C. Episcopal Corporation has taken steps towards the erection of a block of workmen's cottages at a cost of about $100,000. The houses will contain seven rooms and bath, and will be heated by hot-air furnaces. Water and sewer connections will be installed by the city and the work of construction is expected to employ at least three hundred men.

The Canadian Northern Railway has just placed an order with the Canada Car & Foundry Company, the Hamilton National Steel Car Company, the Crossen Car Company, and the Preston Car & Coach Company, for more than one-and-a-half-million dollars worth of equipment for the company's service between Toronto and Winnipeg, by way of the new line from Port Arthur to Sudbury.

The Department of Public Works has commenced operations on the construction of a new dock at Port Coquitlam, B.C., alongside the mill of the Coquitlam Shipbuilding and Marine Railway Company. The new dock, which is to replace the old structure, will extend much further into the river. The approach will be three hundred feet in length, with a "T" 40 ft. by 40 ft. in size, on which will be erected a freight shed of 16 ft. by 24 ft. dimensions.

The steel work has been completed on the extensive plant of the Saskatchewan Bridge & Iron Company, at Medicine Hat, Alta. A railway spur was constructed recently and seven car loads of iron and brick have been shipped to the factory site. The buildings will represent an investment of approximately $100,000, and when the plant is in full working order employment is expected to be provided for about one hundred men.

The construction of a new picture theatre at the corner of Rose street and 11th avenue, Regina, has been completed at a cost of about $50,000. The building is mainly of brick and a circular entrance, surmounted by a dome, forms an imposing front. The decorative work, which is said to be unique as well as artistic, was carried out by a Chicago firm. The architects for the theatre, which has seating capacity for about one thousand people, were Messrs. Tripp & Rowley, of

Regina. The contract for the construction of a new Empress theatre in Regina has been awarded to Mr. T. R. Davidson, of Regina.

Engineers of the Dominion Public Works Department hope to complete this fall the survey of the Saskatchewan River, on which they have been engaged for three years. They are planning a new means of transportation in the form of a 5 ft. waterway from the Rockies to Winnipeg, which would be sufficient for barge traffic. The cost is estimated at approximately $15,000,000, the principal items of expenditure being a series of locks along the river.

The rural municipality of Assiniboia, Man., is contemplating the installation of three separate systems of sewerage and waterworks in the east half of the municipality, and it is reported that the cost of the scheme will approximate $500,000. As briefly referred to in the Contract Record of July 22, the present intention is to sink wells in order to furnish a water supply, but as this municipality comes within the scope of the Greater Winnipeg Water Scheme a supply will eventually be provided from the latter source. Engineers are at present working on the necessary preliminary surveys, which will probably take two or three months to complete. Mr. G. W. Rogers of Kirkfield Park post office, is the municipal engineer-in-charge.

Canadian Railroad Development

Mr. W. J. Bowden, Chief Engineer of the Department of Railways and Canals, has left Halifax on a tour of inspection of the work on the Hudson Bay Railway terminals at Port Nelson. He will also superintend the installation of twelve light ships along the shores of Hudson Bay.

The work of completing the National Transcontinental Railway will, it is expected, be completed and the line ready for operation in October. By that time the car ferry, which was constructed in England, will be in position for the conveying of trains between Quebec and Levis. This will provide a through connection for the whole line of the Transcontinental Railway. About 1,100 men are said to be employed upon the construction work at the present time.

Work upon the Alberta and Great Waterways Railway, now under construction from Edmonton to Fort McMurray, is advancing steadily, according to a recent report made by Mr. R. W. Smith, chief engineer, who has made an inspection of the line as far north as Lake La Riche, accompanied by Mr. Norman L. Harvey, Secretary of the Provincial Department of Railways, and Mr. E. H. Ellison, Divisional Engineer. It is expected that the grade will reach the lake this fall.

It is estimated that the work of double-tracking the entire line of the Canadian Pacific Railway will involve an outlay of more than $100,000,000. The undertaking is to go on continuously from year to year until the whole system is double-tracked. It is not the intention of the company to proceed with the double-tracking along the Thompson and Fraser rivers until 1915, by which time the Kettle Valley line will be ready for traffic and an alternative route thus provided.

Plans which have been prepared by Messrs. Warren & Wetmore, architects, provide for the construction of an up-to-date building of steel and concrete, for the new passenger station about to be erected for the Canadian Northern Railway Company on a site at the corner of St. Montique and Lagauchetiere streets, Montreal, pending the construction of permanent terminals. The building will be two storeys above and one storey beneath street level. It will have a frontage of 150 feet with a depth along St. Montique street of about 100 ft. The facade of the new depot will be of stucco with marble columns. The cost of the structure, which is to be completed next May, will approximate $250,000.

The C. P. R. is said to have expended during the past two years approximately two and a half million dollars in improvements on the Dominion Atlantic Railway, which is now virtually part of the Canadian Pacific Railway system, although not yet formally taken over. The largest individual work was that of the Bear River bridge, which necessitated an outlay of one and a half million dollars. Other new bridges are those across the Avon, at Windsor, over the Gaspereau River and at Weymouth. When this road is brought up to the regular standard and taken over by the C. P. R., it is anticipated that the run from Halifax to St. John, N.B., will be reduced to about six hours.

Personal Mention

Mr. Ross H. McMaster, of Montreal, has been appointed a director of the Steel Company of Canada, in succession to the late Senator Gibson.

Mr. Gerald Ponon, C.E., of Calgary, Alta., has been investigating the various systems of roadbuilding in England during the past few weeks.

Mr. Thos. Turnbull has been appointed Assistant Chief Engineer of the Canadian Northern Railway, with headquarters in Winnipeg. Mr. Turnbull, who is a native of Ontario, was formerly connected with the C. N. R., and for the last four years was with the Canadian Pacific and the Hudson Bay Railroad.

Mr. W. C. Brennan has been appointed works commissioner of Fort William, Ont., in charge of construction and maintenance of roads and sewer work, etc. Mr. Brennan was formerly secretary of the Department of Public Works, Hamilton. He has held similar positions in various parts of Canada for the past twenty-four years.

Mr. D. Howard Martin, C.E., has been appointed Chief Engineer with the firm of Messrs. Jas. H. Corbett & Sons, Kittaning, Pa., contractors for Section 5 of the new Welland Ship Canal, with headquarters at Allanburg, Ont. Mr. Martin recently filled the position of Divisional Engineer of the Pittsburgh and Shawmut Railroad, Brookville, Pa.

Mr. W. P. Dobson was recently appointed Director of the Experimental Laboratories of the Hydro-Electric Power Commission of Ontario. Mr. Dobson has been carrying on research work within the last two years on the electrical disturbance in high tension transmission systems for the University of Toronto Engineering Alumni Association.

Mr. Ralph Modjeski has been retained by the Burrard Inlet Tunnel and Bridge Company of British Columbia, to report on tenders which the company received some time ago for the construction of the Second Narrows Bridge, Vancouver, at a cost of about $2,000,000. Mr. Modjeski is a well-known consulting engineer in Chicago, and a member of the board of engineers of the Quebec Bridge.

In accordance with the Good Roads Act in Canada, the following provincial appointments are announced in the Manitoba Gazette: Chief Engineer, Mr. M. A. Lyons; Engineers, Messrs. S. A. Button, T. T. Wilson, J. B. Phillips, W. Youngman, R. Whitside, and F. Minnville; Assistant Engineers, Messrs. W. R. Bertram, L. Cote, W. H. Bladock; Inspector, Mr. H. T. Thornby; Draughtsman, Mr. C. W. G. Milne.

Mr. J. S. Meadows, who has been in railroad work for fifty-seven years, twenty-seven of which have been in Canada with the G. T. R., celebrated his golden wedding in Toronto a few days ago. Mr. Meadows is a native of Northamptonshire, Eng. He gained expert knowledge of engineering and was amongst those chosen to build the Triumphal Arch on London Bridge for the arrival in London of Queen Alexandra. He was also engaged in the building of an underground railroad in London from King's Cross to Farringdon Road. He was afterwards employed as Construction Superintendent in various parts of Great Britain. His work in the Grand Trunk service was chiefly on the auxiliary in wrecks.

Sir Sandford Fleming, whose re-election for another term of three years as Chancellor of Queen's University, Kingston, took place recently, has held that office continuously since 1880, in which year he became Chancellor of the University. In 1887 he was elected to the presidency of the Royal Society of Canada, receiving his K.C.M.G., ten years later. His distinction in engineering was attained when he filled the position of Chief Engineer during the construction of the Canadian Pacific Railway. He has written a large number of scientific works dealing with subjects of practical interest to engineers.

Mr. T. R. Perkin, formerly Assistant Manager at Toronto of the Pedlar People, Limited, manufacturers of sheet metal products, has been transferred to the Winnipeg office as the firm's western manager. Mr. Perkin, who has already taken up his new duties, has been with the Pedlar People, Limited, for many years and his promotion to this position is a recognition on the part of the firm of his capability as a salesman.

After spending several days inspecting terminals and terminal plans in Toronto, Montreal, Boston and New York, the Chicago Railway Terminal Commission sailed on July 14 for a six weeks' study of European railway terminal facilities.

Trade Notes

The Fibred-Asphalt Paving Company, of Canada, has been formed with head office at 9 Front Street E., Toronto, to manufacture fibred asphalt—a new pavement, for the manufacture of which patents have been secured in Canada, the United States, and several European countries.

A Canadian branch of the Independent Pneumatic Tool Company, whose works are at Aurora, Ill., has been opened at 334 St. James street, Montreal. Mr. W. H. Rosevear, who was formerly connected with the London Concrete Machinery Company as Winnipeg representative, is the manager. The Independent Pneumatic Tool Company are manufacturers of the "Thor" line of pneumatic tools, which include drills and hammers.

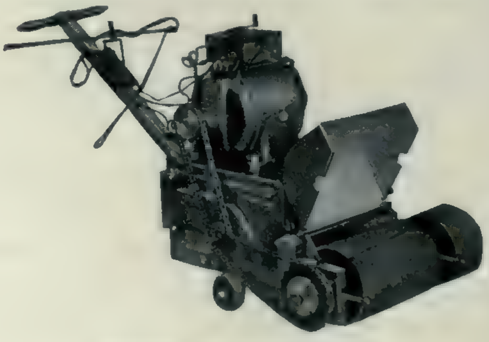
The Galt Wire & Ornamental Iron Company, Limited, a new company whose headquarters are at Galt, Ont., are taking up the manufacture of a general line of ornamental iron and wire goods, specializing in grille work for banks, offices, etc., metal lockers, elevator enclosures, wire guards, and railings. The firm have also installed an up-to-date plating plant which leaves them in a position to handle any kind of brass, bronze or copper oxidized finishing. The plant consists entirely of new machinery and the necessary facilities therefore are at the firm's disposal to do a large volume of business. The General Manager, Mr. John Spalding, is a thoroughly practical man, having been for a number of years in charge of the grille department for the Otis-Fensom Elevator Company, Hamilton, Ont.

The application and influence of mechanical draft form the subject of two interesting catalogues issued recently by the B. F. Sturtevant Company of Canada, Limited, Galt, Ont. The various conditions it meets are described in Bulletin No. 178, in which the adaptability of the appliance to local conditions and its success in reducing power cost is clearly demonstrated. Bulletin No. 199, which is also before us, describes in detail the Sturtevant "Monogram" fan. This fan, so-called because of the monogram "B. F. S." cast into the casing, bears the hall mark of efficiency. The company already have installed over 68,000 of these fans. They are built either as blowers or exhausters, in four discharges, either right or left hand, and are adapted for direct connection to electric motors, or steam turbines. They can also be belt-driven from engine, motor, or counter shaft.

Wire Reinforcement for Brick Work

There has just been placed on the market a new type of wire reinforcement for brick work for which several advantages are claimed. This reinforcement consists of four parallel strands of No. 7 B.W.G. galvanized steel wire of high tensile strength, tied together by means of crimped bands of galvanized hoop steel placed about 8 inches apart. The fabric is 2½ ins. wide and is finished in rolls of 75 ft. It is claimed that this reinforcement will make ordinary brick work monolithic and that it can be used with safety in place of steel beams or arches over openings. The building by-laws of Montreal and Winnipeg permit of certain reductions in thickness of brick walls, where reinforcement of a suitable type is used. For instance, the cost of a 12-in. wall will be reduced 20 per cent if reinforcement is used. The cost of this fabric, in place, in ordinary work, including labor and material, is about $5.50 per thousand bricks; the actual labor cost being 50c per thousand. It is claimed that a saving of from $10 to $15 per thousand brick can be effected by using this wire fabric. Mr. W. Sharp, of Francis Hankin & Company, Montreal, is the patentee of this new product which will be sold under the trade name of "Mono" brick reinforcement. Patents have been applied for in all countries. Francis Hankin & Company, Coristine Building, Montreal, are the Canadian sales agents.

The Automatic ball-bearing, electric floor-surfacing machine, manufactured by Wayvell Chappell & Company, 4845 Ravenswood Avenue, Chicago, Ill., illustrated herewith, is becoming very popular amongst building contractors and floor layers. It is claimed that this machine rapidly refinishes old floors, taking off old varnish, paint, shellac, etc., and that it will also dress quarter-sawed oak, maple, etc., in any manner required. Solidly built, all heavy parts accurately assembled, the machine is fitted with heavy steel ball-bearings on all running parts so that the cutting roller and the two 9-in. diameter suction fans, to which the dust sack is attached, spin true and easy. The roller may be either flexible for easy adjustment to floor inequalities or rigid to level the floor quickly. It is claimed to be the only machine having a mechanism to brake the machine for easy work and to gauge the depth of the roller cut. This brake gauge, the bottom of which is of polished wood, gauges the depth of cut by holding firmly the handle in any position by means of a small lever. The surfacing machine is made in several sizes, suitable for small rooms or large areas.



Automatic floor-surfacing machine.

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WINNIPEG - Telephone Garry 856 - 302 Travellers' Bldg.
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**Alphabetical Index of Advertisers
Page 18**

Vol. 28 **August 12, 1914** **No. 32**

Principal Contents

Canadian Constructional Activity—Retrospective and Prospective 1007-08

Engineering Topics in the Old Land 1008-9
London, Eng., Correspondence

The Deposit Cheque 1009

Profitable Conversion of City Garbage 1009-10

Burned Asphalt Cement can be Prevented 1010

Sewer Excavation with a Revolving Shovel 1010

The Various Types of Movable Bridges—Part II... 1011-16
By W. M. Wilson

Conscience in Municipal Engineering 1017-18
By Alfred Williamson

A Contractor's Cost Account System 1018-20
By C. E. Anderson

Practical Points in Modern Road Work 1021-23
By W. H. Maxwell

Collapse of a Port Arthur, Ont., Wharf 1023

The Efficient Operation of Dynamite 1024-26
By Charles E. Anderson

Inclined Conveyor Belts Handling Wet Concrete ... 1026

Modern Methods of Preventing Explosions in Sewers. 1027

An Engineer's Canoe 1028

Efficiency in the Waterproofing of Cement Surfaces 1028-30
By G. H. Cresser

Fraser River Development 1030

Cement Joints in Sewer Pipe 1030-01

M. J. Haney—Biographical Sketch 1032

Constructional News 1033-4

Industrial and Miscellaneous 1035

Canadian Constructional Activity—Retrospective and Prospective

WARS and rumors of wars notwithstanding, we find something to be thankful for in the constructional activities of the first half of 1914. In a time of business uncertainty like the present it may be well to take fresh heart by looking at a few figures squarely in the face. Such examination at least gives us sufficient ground for believing that the constructional projects to which the various interests in Canada have committed themselves will provide reasonable activity for the remainder of the season.

Taking the thirty cities of Eastern Canada from which returns are available, we find that building permits totalling in value $36,985,766 were taken out in the first six months of the present year, as against $40,902,521 in the same period of 1913. Thus a decline of only 9.5 per cent is shown. In 1914, from January to June 30, the estimated value of new buildings in Montreal was $8,521,910, while for the same period last year the figures were $9,942,286—a decrease for the current year of some $1,400,000. Although there is a decrease in value there is an increase in the number of building permits taken out. An examination of the figures for Toronto discloses the fact that the two corresponding half years are practically equal. The number of building permits issued from January 1 to July 31, 1913, was 4,470, while for the same period this year the total is 4,901—an increase of over 400. It is gratifying to find that more building permits were issued in Toronto during July of this year than in the corresponding month of 1913, the figures being, July, 1914, 997; July, 1913, 783. In the Western cities of Canada a decline of only 3.8 per cent in the value of buildings under construction is recorded. Taking the forty-seven cities of Canada from which returns have been received, there is a reduction of 20.8 per cent.

Regarding the financial status of the Dominion, a note of encouragement is found in the fact that there is as much ready money in Canada to-day as ever before. Savings deposits increased from $398,000,000 in 1908 to practically $664,000,000 in 1914—every year having shown a substantial increase. The money situation has been the subject of wide discussion all over the Dominion and leading authorities are agreed that Canada is as generously supplied with money today as ever in the past.

Glancing over the record of building in the forty-three cities of the Dominion, we find that constructional activity during the last six months has been on the increase in eighteen cities, the most noticeable increases having been recorded at Winnipeg, Medicine Hat, St. Thomas, Ont., St. Catharines, Berlin, Quebec, Maisonneuve and Halifax.

Crop conditions in the Western provinces are generally reported excellent.

Optimism has ever been a strong characteristic of the Contract Record, but optimism, like everything else carried to excess, "begets peculiar pain" sometimes. For some time business conditions have not been what they might have been, and now that Great Britain is entangled in a general European war it is hardly likely that any rapid improvement will come about. It is reasonable in such a time as this, however, to take heart from the past achievements of empire and country and pursue our way quietly and conservatively in the calm confidence of ultimate success. No foreign power can stem the tide of Canadian development while British prestige is maintained and surely we have sufficient justification for believing that Canada's destiny within the empire is beyond the reach of an army of kaiser wilhelms. The trade depression which existed before the war was of a shallow character. For the present we are persuaded that the wise policy is to lie in wait patiently, avoiding wild retrenchments which must re-act subsequently upon ourselves.

Engineering Topics in the Old Land

British Trade in Canada—The Currency Question—Cost, Efficiency and Time, Factors of Primary Importance—The Fetish of Numbers—"Road Machine" a Crank Invention—"The Times" at Fault

London, Eng., Correspondence of the Contract Record and Engineering Review.

"British Trade in Canada"—an editorial which appeared in the "Contract Record" of June 17th—has aroused considerable interest "on this side." The currency question is always one which must loom large in international relations until a universal standard is adopted, and the time has long passed when at least English-speaking nations should have arrived at a common currency. To the English business man the dollar is as confusing as the anna and the rupee, and seekers of appointments in the Indian Empire (it is worthy of note) are always fearful of being "diddled" when the emoluments are set out in what is to them a foreign coinage. The dollar remains practically constant, and the rough and ready rule here is to divide the number of dollars by five and call the result pounds, (some seven-pence halfpenny in the pound being thus left over to the good); but the converse operation is not quite so easy. This is beside the question as dealt with in the article mentioned, however. In that the action of British manufacturers in sending out catalogues and price lists containing quotations in English currency was deplored, and it was said "This has been a source of much trouble to Canadian business men. In cases, owing to deductions allowed for discount and other charges, they have been obliged to consult the Customs authorities on the question of adjustments. It is difficulties such as these that cause the Canadian agent to look upon British agencies with less favor." It certainly seems surprising, but it is none the less true, that a great percentage of English people do not realize the difference in currency of the two countries. America and dollars are synonymous terms; but it is not so with Canada, which is regarded by such misguided people as a variant on Australia, and included within the comprehensive expression—the Colonies. Anyway, think these worthy people, both currencies are in use in Canada, as witness the money orders which are often worked out in dollars and in pounds, shillings and pence.

Tenths, Twelfths and Sixteenths

In matters commercial, elimination of unnecessary complications is all-essential. A universal standard of currency the world through must await the Millenium, but if England had not been the most conservative of nations the decimal system would long ere this have superseded the intricate system of values, weights and measures that is no system at all. English-speaking countries should be able to trade upon a common basis, and that basis must inevitably be dollars and cents. It is too late now to consider whether the decimal system is the best that could be devised. In the opinion of the writer, the duodecimal, working in twelfths, would be a considerable improvement. Twelve is divisible by two, three, four and six; ten is divisible by only two and five. The natural way of partition is by halving, and regarded from the point of view sixteenths would be preferable to twelfths; but duodecimals are already largely used in calculations, by, among others, English-speaking engineers, architects and builders. It is but seldom that one divides an article into tenths. Halving is, as has just been said, the natural method of breaking up, and one thus gets halves, quarters, eighths, sixteenths and so on, each fraction increasing the difficulty of decimal representation. This again, by the way; although the matter is one which might be discussed with advantage from the standpoint of the engineer. Perhaps those readers of the Contract Record with whom mathematics is a strong point might commit their views to writing.

Cost, Efficiency and Time

Much, far too much, has been written and spoken concerning the relations between Canada (and other countries) and the mother country. Sentiment is to be encouraged, provided it rings true; and as much may be argued for patriotism. Dr. Johnson is said to have defined patriotism as the last resource of a scoundrel, and the definition has certainly a substratum of truth. Only too often is the Union Jack waved in one hand merely for the purpose of diverting the attention from the other hand which is wandering into strange pockets. The Union Jack is but a poor commercial asset when dealing with civilized nations. Backed up by guns and a field force, it certainly "promotes" trade in savage districts; but then there is no competition to meet in such places, except perhaps that of the medicine man or witch doctor. "In this competitive age," says the article in the Contract Record, "cost, efficiency and time are factors of paramount importance. The purely sentimental regard that the British have for the British is a matter of small count when it comes to dollars and cents—and service." If England can buy wheat of similar quality a farthing a quarter cheaper from Russia than she can from Canada, further argument is at an end. Unfortunately this solid fact has not been fully recognized, and the English trader has relied too much upon the Union Jack in the pushing of his wares, neglectful of the factors of "cost, efficiency and time." It is a worthy object to strive for "the improvement of trade relations between the mother country and the Dominion." Canada is "a land of great opportunities, and her prizes are worth the winning," but "they will be offered for the best service, irrespective of whether that service comes from Canada, the United States or Great Britain."

The Fetish of Numbers

The address of Mr. H. N. Ruttan, retiring city engineer of Winnipeg, to certain Winnipeg engineering students, brings to the mind very forcibly the necessity for more frequent intercourse between municipal engineers. Conventions and conferences on a big scale are well enough in their way as show pieces, but there is little of a practical nature to be derived from them. The numerical strength alone of these gatherings militates against their usefulness, and resolutions and amendments are a very harsh form of diet. Too much respect is in fact paid to the fetish of numbers. "The more the merrier" should not apply in the case of the professional society meeting. Selection should then be the criterion, and five or six assembled together might carry through a most useful programme. Meetings would be called much oftener were secretaries not afraid of what is termed a bad attendance, and yet when a big number does meet, actual business has to be referred to committees and nothing much else is ever done except to receive the report of committees that have been appointed at prior meetings. If five or six was regarded as a satisfactory attendance, many hundred more meetings would be held annually, and the profession would benefit correspondingly. In many parts of Canada, where communities are scattered at vast distances apart, large meetings of those in the same profession or calling are impossible. Why not then let two form a quorum?

The "Road Machine"

Someone has been pulling the leg of "The Times." In a contributed special article "Model British Roads," fulsome praise is bestowed upon a crank invention known as the "road machine," which has been fixed up at the National Physical Laboratory at Bushey. The machine is referred to as "an interesting innovation for testing the durability of new road materials. It consists of a track, 100 ft. in length, in circular form. On this the engineers can lay down any piece of roadway which they wish to test. A motor-driven framework on eight wheels, which is loaded to any desired degree and run at any desired speed, is then driven over this experimental stretch so as thoroughly to test its durability. By this device the engineers are able in a few months to test the quality of any new material or any new design or roadmaking just as thoroughly as if it had been laid down for eight or ten years. As no new system of road treatment can be relied on until it has been subjected to actual trials, the time saved by the machine has facilitated considerably the new developments of recent years." The article was written possibly by the inventor of the machine or by one of the scientists of the Laboratory (Colonel Crompton, mayhap), or it might even be from the pen of the gentleman (well known in road circles here) whose articles on road carpets and road crusts speedily leaped into popularity owing to their having no vestige of practicability. To the mind of any of these three the machine would strongly appeal as being eminently unpractical. But to the engineer —the man who has to make roads and not merely to tinker with petty idiosyncracies concerning their make—the machine is a laughing-stock, the "actual trials" a farce, and the "facilitation of developments" a snare and a delusion. And "The Times" devotes a half column leading article to a flattering substantiation of the statements in its contributed article! May it be hoped that "our friends on the Continent who are coming to us to learn how road-making is done" will estimate the work of the "road machines" at its true value, and not be led away by obvious "puffs."

The Deposit Cheque

In the Contract Record for July 15 we related how the deposit cheque of a Toronto contractor was refunded in spite of the Mayor's unqualified disapproval of such procedure. The Mayor contended that such a policy encouraged collusion among contractors. Among our readers His Worship has one supporter in Mr. Chas. Curtis, President of Western Pavers, Limited, Winnipeg, a gentleman of extended experience in large contracting operations. Mr. Curtis writes us: "I am of the opinion that Mayor Hocken was right in his contention that the deposit cheque should have been forfeited. The sooner such forfeiture is put into effect the sooner municipalities will get rid of 'the catch-as-catch-can contractor.' In Western Canada—not in Western Canada alone—one encounters many contractors whose whole ambition is to tender below the other fellow and run chances on getting through the job at a profit. These are the contractors with whom it is in the best interests of the municipality to avoid dealing as there is too great a tendency to skimp the work when an opportunity arises. By returning the deposit cheques to such contractors it is simply an invitation for them to take another chance. In respect to collusion, however, I am not in agreement, as the object of having the Commissioner of Works submit a tender is to prevent concerted agreements and the Commissioner surely figures his estimates of cost before submitting his tenders, otherwise they can be of no more value than those of 'the catch-as-catch-can contractor.'"

Profitable Conversion of City Garbage

A method of garbage disposal which is finding considerable favor in England and which has been adopted amongst other towns in Southwark, Hove, Halifax, Blackpool, etc., consists in converting the house refuse collected by municipalities into a marketable fertilizer. The plant, as described by a correspondent of Municipal Engineering, comprises a patent disintegrator or dust manipulator, a conveyor and an electric motor for driving. At Southwark, London, there are four sets of the machinery which are erected in pairs, the two pairs facing each other, the conveyors conveying towards the centre and discharging the output into a railway truck for immediate dispatch. The whole space occupied by the plant is only some 50 feet by 20 feet and no costly buildings are required. The machine which actually does the work is the dust manipulator which is a strong and powerful centrifugal force disintegrator. The dust carts tip their loads on a sheltered platform some 20 feet by 12 feet, where large tins and leather, which fetch a good price, are thrown aside by the workmen, while the remainder, including broken glass, crockery, slates, wood, and small tins, in one word, the whole of the unpicked refuse, is shovelled into the hoppers of the machines for treatment. In a second or two after entering the machine the house refuse finds its way out and falls on the conveyor in a uniform mass which cannot well be distinguished from dark, rich loam. Occasionally, a few very small bits of paper appear here and there on the surface, but these disappear very quickly owing to the disintegrating action of a rapid fermentation accelerated by the pounding the refuse received while passing through the machine. One very noticeable point is that immediately after treatment this mass, which previously had a most unpleasant smell, has entirely lost it and is not objectionable. The stuff thus treated is now ready to be spread at once on the soil as manure. Of the four dust manipulators at Southwark three are in constant use, one being kept in reserve and used when wanted. The output amounted to some 70 tons a day, and the manure sold by the council to farmers and kitchen gardeners in Kent amounts to something like 18,000 to 20,000 tons a year. This manure is sold at 2s. 4d. (56½ cents) a ton. Each machine is capable of treating up to 4 or even 5 tons of refuse an hour. The whole operation is performed in a manner cleanly, quiet, and free from any suspicion of nuisance, and the economical principle of giving back to the soil what comes from the soil is put into practice.

Burned Asphalt Cement Can Be Prevented

FEW contractors realize the seriousness of burned asphalt cement and the amount of money lost through this cause. Pavements crumble away and yet hardly any attention is paid to this particular cause of their crumbling. Hardly any contractor would risk using hydraulic cement in his concrete that he knew had been spoiled, because common sense would tell him that he might have to take all the concrete up again, and yet he seldom stops to think that his asphalt cement may have been burned and therefore spoiled, and that he may have to take up his course of top and binder as a consequence. Experience has proved that when steam at a pressure of 125 pounds and without superheat is used in coils placed across the kettles, the asphalt cannot exceed 350 deg. F. and in kettles properly constructed for the purpose, the heating of a large mass of asphalt takes much less time by this means than with furnace heat applied to the exterior of the kettle at a temperature of at least 1200 deg. F. Also, no burning takes place; whereas, in the case of furnace heat at 1200 deg. F. all asphalt coming in contact with the part of the kettle nearest the furnace is burned in spite of any agitation given it. Where furnace heat is used, the vital operation of heating the asphalt cement generally depends upon the intelligence of a $3.50 per night colored man. He, as a rule, is no more conscientious than an average hired laborer, and as the superintendent cannot work 24 hours every day and watch the night work as well, takes frequent advantage by sleeping during the night and then firing very heavily towards morning to have the A. C. hot enough for the morning. This cannot occur with steam heat. It has also been proved that steam heat is more easily regulated and the resultant penetrations have been more regular as a consequence.

Asphalt manufacturers are adopting steam heat more and more every day as they realize the danger of furnace heated kettles spoiling their products.—Municipal Engineering.

The lowest grade considered satisfactory for successful operation of flumes is approximately 1 per cent, but it is better to maintain a grade of from 2 to 5 per cent when possible, according to a statement by E. S. Bruce in Bulletin 87 of the U. S. Department of Agriculture. The maximum grade that can be used runs up to a very high pitch. Some flumes have been successfully operated for a short distance at a grade of 30 deg., but such a steep grade is undesirable as it is difficult to maintain a sufficient volume of water in the flume. The most satisfactory results in fluming are obtained at grades of from 2 to 10 per cent, and grades above 15 per cent should be avoided whenever possible.

Sewer Excavation With a Revolving Shovel

A Washington contractor has been operating a revolving shovel for digging sewers in and about the city of Washington. The success which he has attained makes it well worth while to study his method of operation.

The shovel is equipped with a 27-foot handle, enabling it to dig to a depth of 18 feet, below the bottom of the wheels. The dipper has a capacity of ⅞ of a cubic yard. It is fitted with five forged teeth, three on the front, and one on each side. These teeth are intended as side cutters in order to assure sufficient clearance to lower into the ditch easily after a cut has been made. The neatness of the ditch cut is very noticeable.

This machine has been used recently for digging ditch for sewer pipe and also for concrete and brick sewer. The most recent job was a ditch for an 18-inch sewer pipe. This ditch is 3,300 feet long, varying from 10 to 27 feet in depth. The material is hard clay with a little shale at the bottom. As some of the work was done when the bottom was somewhat frozen the digging was very hard.

For the concrete and brick sewer, the shovel excavated a trench 18 feet deep, seven feet wide at the top and an average of five feet at the bottom. This sewer had a concrete invert and a brick arch. The speed of the building invert and the brick arch governed the whole progress of the work. The shovel under these conditions made about 65 feet advance a day, but this naturally is not an index of its capacity.

The material was loaded into two-yard side-dump cars travelling on light rails laid alongside the trench. This material was hauled back and dumped directly into the backfill. This method was pursued whenever possible. In a few places, however, owing to local conditions, it was necessary to overcast a small amount of material, which was later rehandled. The excess material not required for backfill was taken away in wagons. The bracing of the trench was put in by hand and small jack screws at the ends of the blocks held the sheeting in place. Two men were used for pushing the cars, although at times a mule was employed.

The concrete invert was laid immediately back of the shovel in the trench dug by the shovel on the preceding day. The brick arch was built on the second preceding day's invert and was allowed to stand a day before the backfill was placed upon it. This, as will be seen, left 200 to 300 feet of open excavation. Hence it was necessary only to keep the shovel ahead of the concrete gang. The organization of the job was so well planned, that a very few men were employed.

The shovel is mounted on traction wheels, to which are rivetted circumferential bands formed of channel iron, which give a double flange on the wheel. The shovel runs on rail sections about three feet long, mounted on 12 x 12-inch timbers. These timbers, seven in number, span the trench. They are in reality long chair ties. In order to move forward a chain sling, hung over the dipper handle, was hooked into I-bolts in the chair ties, or timbers.

The Various Types of Movable Bridges*

A Comparison of the Many Modifications of Swing, Bascule, Direct-Lift, Pontoon and Transporter Bridges and Their Bearing Upon Transportation: Features of Design and Adaptability to Varying Conditions.

By W. M. Wilson†

PART II.

THE double leaf bascule span of the Rhode Island stone bridge over the Sakonet River, between Portsmouth and Tiverton, R.I., is of a very similar type. Instead of making use of cables the front end of the moving leaf is supported by means of struts, which are pivoted to a carriage running on a curved track supported on a tower over the approach span. The carriage carries the counterweight and the track is so curved as to cause the bridge to be balanced in all positions. When the bridge is closed the carriage is brought up against a bumper so as to enable the pivoted strut to support the front end of the moving leaf under the action of the live load. The design was made by Mr. Augustus Smith, of New York. The bridge was completed in 1908.

One of the competitive designs submitted for the bridge over the Calumet River at 95th street, Chicago, is a double leaf bascule bridge, for which the moving leaves are supported by cables which pass over pulleys on the top of towers. Attached to each pulley is a large spiral over which passes a cable that supports the counterweight. The counterweight slides between vertical guides and the spiral is so formed that the moving leaf is balanced in all positions. This design was submitted by the Milwaukee Bridge & Iron Works in 1900.

A steamboat striking the pivot pier of the swing bridge which carried the New York Central and Hudson River R. R. over the Harlem River at 135th street, New York, a point where the traffic is congested, while not putting the bridge out of commission impressed upon the officials of the road the desirability of having an emergency draw span to be used in case the regular span should be out of commission. A bridge was put in place of the fixed span adjoining the swing span. It consists of a double track plate girder span hinged at one end and resting upon a pier at the other. Cables fastened to the outer end of the moving leaf pass over a wheel supported on a tower, down to and around the drum of a hoisting engine and thence up and over wheels at the top of the tower. Weights hung on the end of this cable balance the bridge. There are two sets of these weights and each set is made up of 23 parts placed one upon another. The cable passes through holes in the centres of the top 22 weights and is fastened to the 23rd

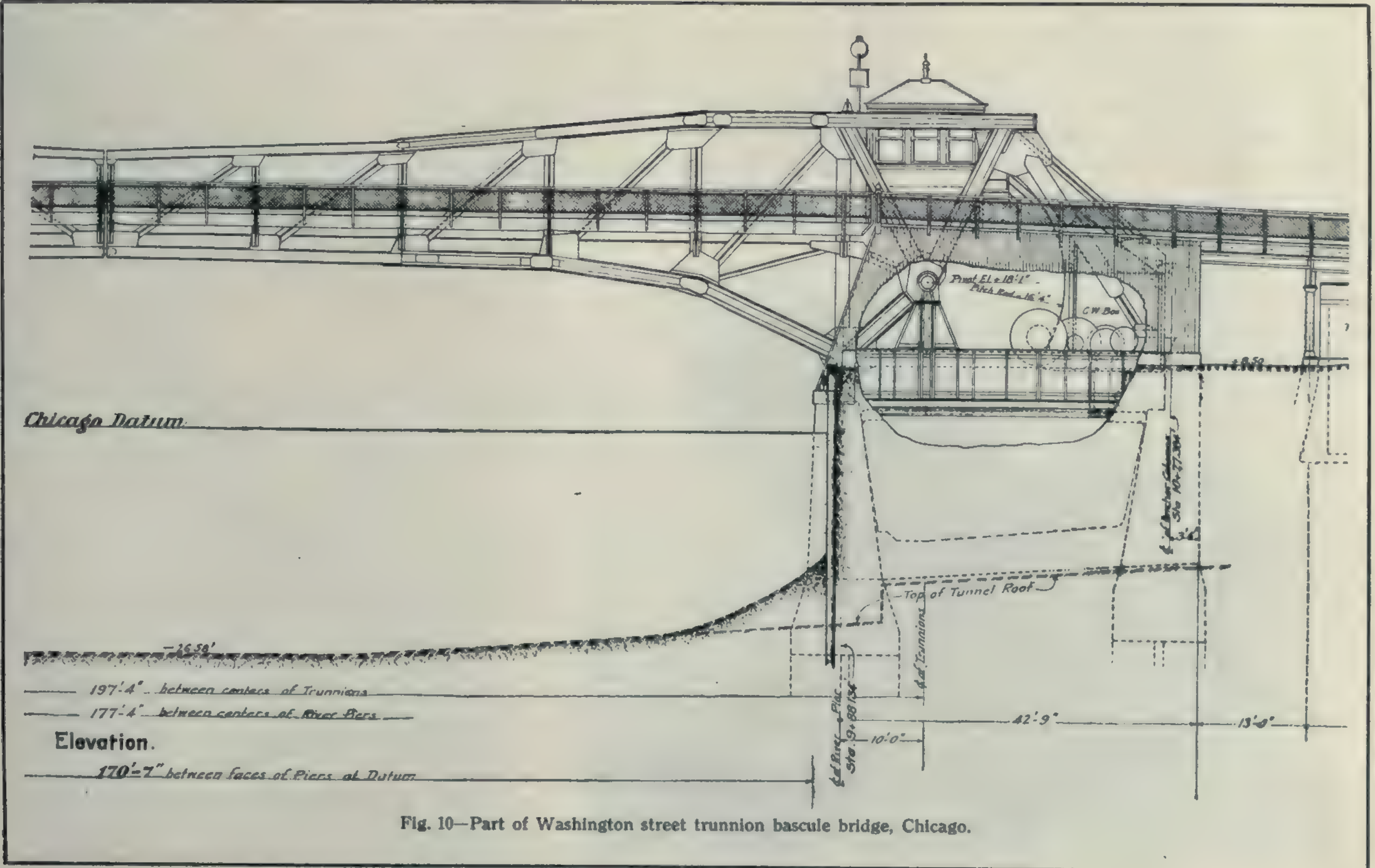

Fig. 10—Part of Washington street trunnion bascule bridge, Chicago.

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† Assistant Professor of Structural Engineering in the University of Illinois.

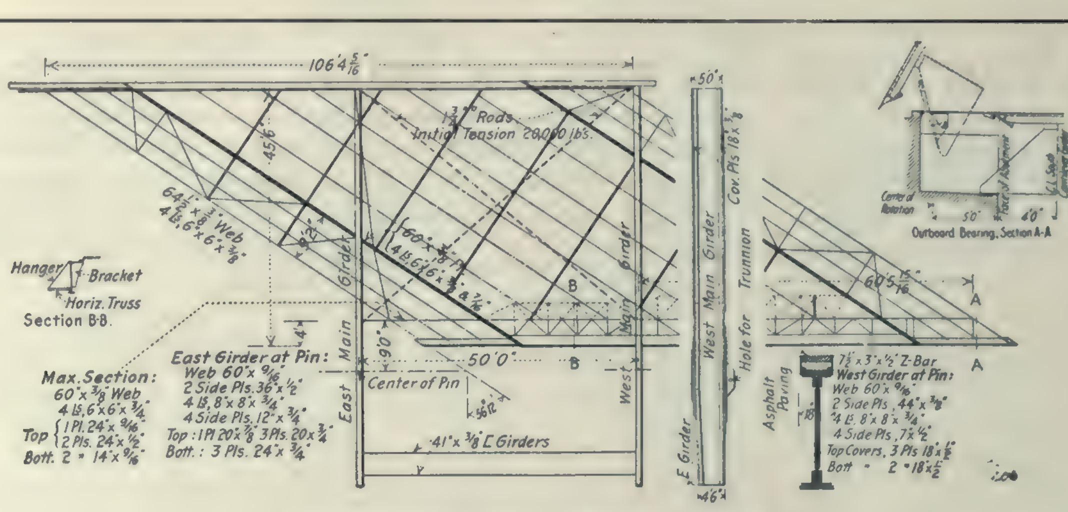


Fig. 11—Skew bascule bridge at salina street, Syracuse, N.Y.

weight. Brackets project from the weights and engage projecting angle supports on the tower provided for the purpose. These supports are so arranged that one after another of the weights is removed as the counterweight is lowered so that just enough remain on the cable at each position to balance the bridge. The bridge was designed by Mr. G. H. Thompson, then Engineer of Bridges for the N. Y. C. & H. R. R. R. It was built about 1892, and was afterwards used as a temporary bridge during the reconstruction at Spuyten Duyvil Creek.

The jack-knife type of drawbridge was used over the Chicago River at Weed street, Chicago. The bridge is composed of two similar leaves. Each leaf is made up of two parts connected by a hinge. Steel rods extend from the top of a tower to the outer end of the leaf and steel cables from the top of the tower to a point near the hinge connecting the two parts. The rear part of the leaf is pivoted on a fixed trunnion near its centre. A counterweight hung from the end of a steel cable passes over a pulley and over a cam. This cam is fastened to a shaft which also carries a drum. A steel cable fastened to this drum passes over and is fastened to a segment which is rigidly attached to the rear portion of the moving leaf. The radius of the cam varies so that the bridge is balanced in all positions. The operation of the bridge is as follows: When the bridge is closed the front end and hinge of the moving leaf are supported by rods and cables respectively passing up to the top of the tower, and the rear portion of the moving leaf is supported on the trunnion. In opening, the rear portion of the moving leaf turns upon its trunnion. The hinge joining the two parts of the moving leaf moves in a circle about the trunnion, and the front end of the moving leaf moves in a circle about the top of the tower. This motion causes the middle of the moving leaf to go up and the two ends to come down, leaving the channel clear between the towers. It was invented by Mr. Wm. Harman and was opened for traffic April 18, 1891.

A bascule bridge over the Cuyahoga River at Cleveland, Ohio, which was built in 1907, was designed by the Cowing Engineering Company, of Cleveland, and is of a type invented by John P. Cowing. The bridge is a double leaf bascule, but instead of the leaves turning about fixed trunnions the rear ends of the girders are made in the form of a circular arc and set in, and roll upon a nest of 29 ten-inch anti-friction rollers arranged in the form of a circular arc. The centre of gravity of the moving leaf is at the centre. As the bridge is opened the girder rolls on the nest of rollers and the centre of gravity of the moving leaf remains stationary.

The original structures over the Chicago River at Chicago were swing bridges. These are being gradually replaced by bascule bridges in order to free the channel of the centre piers. The more recent of these bridges have been designed by the Bridge Department of the city. All of them are of the fixed trunnion bascule type with the counterweight rigidly attached to the tail end of the trusses, and so located as to bring the centre of gravity of the moving parts at the centre of the trunnion.

The first bridge to be designed by the city of Chicago is the one at Clybourn Place. Each leaf is supported by three trusses, each of which is carried on a trunnion whose bearings rest upon longitudinal girders which span the counterweight pit. There is a pair of these girders for each truss and they are spaced just far enough apart to allow the tail

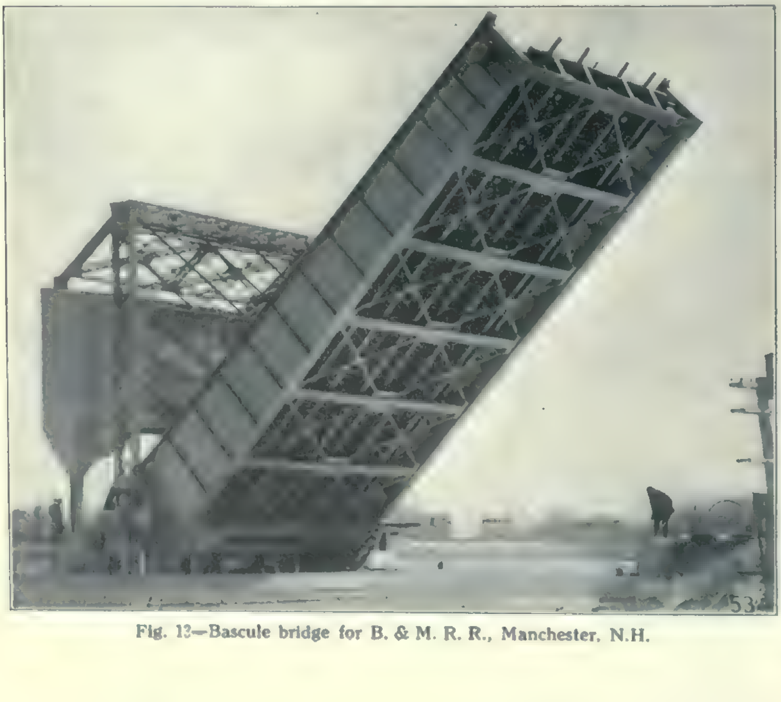


Fig. 13—Bascule bridge for B. & M. R. R., Manchester, N.H.

end of the truss to swing between them The span being comparatively short and there being three trusses for each leaf, sufficient counterweight is obtained by bolting cast iron blocks to the tail ends of the trusses. These blocks are so narrow that they pass between the girders which support the trunnion bearings. This design was prepared by Mr. Edward Wilman, city bridge engineer, and Mr. John Ericson, city engineer, with a view to its adoption for all bascule bridges over the Chicago River.

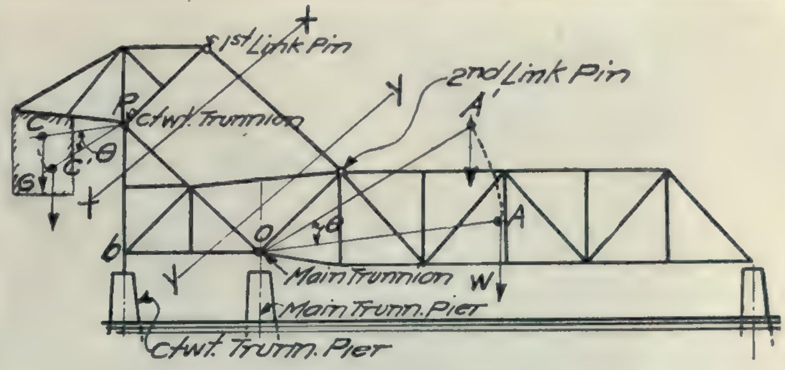
Some of the later bridges had the trunnions supported on inverted A-frames instead of girders. The back ends of these frames were high enough to allow the counterweight to extend from truss to truss, thus increasing the volume and decreasing the unit weight. The Kinzie street bridge is of this type. For both the Clybourn Place bridge and the Kinzie street bridge the live load on the moving leaf is carried on the bascule trusses acting as cantilevers. The main trunnions act as the front supports, and anchors in the masonry hold down the tail end.

A further development is noted in the bridge at Washington street, which has just been completed. Instead of there being a longitudinal girder on each side of the trusses to support the trunnion bearings, a longitudinal girder outside of each truss supports a cross girder which carries the trunnion bearings. This is partly shown in Fig. 10. The cross girder passes through the bascule truss, which is of such design that no web members interfere with the cross girders as the bridge is opened. The absence of the inside longitudinal girders permits of the use of a large counterweight volume and a low unit weight. There is a support in front of the main trunnion to take the live load when the bridge is closed.

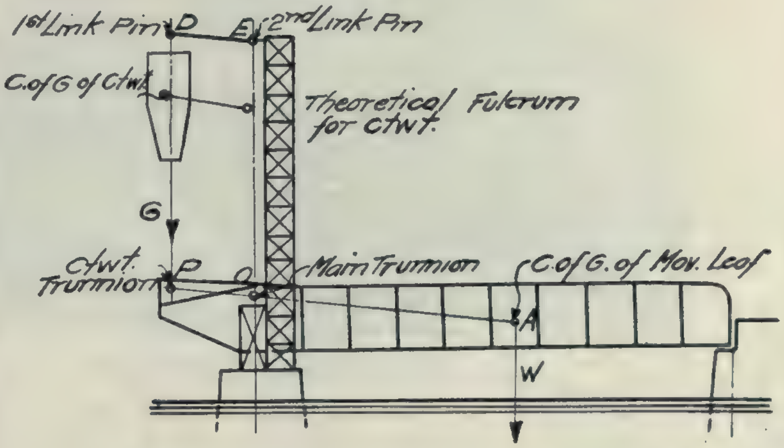
The new bridge at Jackson street, for which plans have been made, is to be of the same general type as the one at Washington street, except that it will be a deck bridge.

The bridge department of the city of Chicago has prepared plans for the proposed bridges at West Lake street and at Michigan boulevard. Both of these bridges are to be double-deck structures and both are designed as double leaf bascule bridges. In the method of handling the bridges and supporting the trunnions they are similar to the one at Washington street.

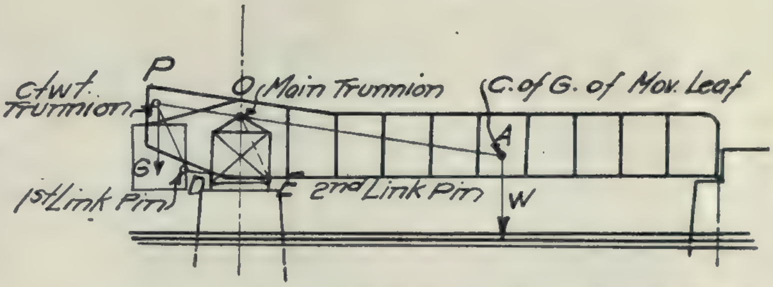
Other fixed trunnion bascule bridges with counterweight rigidly attached to the bascule trusses differ from the bridges just described in having the trunnions above the roadway instead of underneath. The counterweight is over the roadway when the bridge is closed. The False Creek bridge at Westminster



HEEL TRUNNION TYPE



SHORT SPAN-VERTICAL CTWT. TYPE



SHORT SPAN-UNDERNEATH CTWT. TYPE

Fig. 12—Types of Strauss bascule bridges.

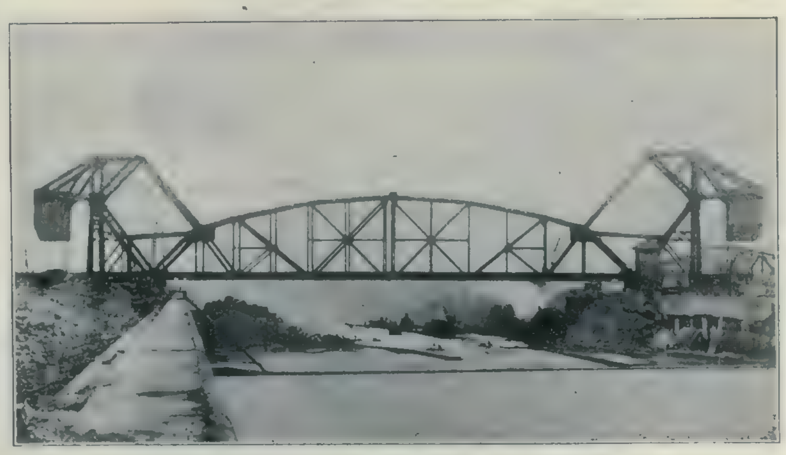


Fig. 14—Bascule bridge for C.P.R.R. at Sault Ste. Marie, Mich.

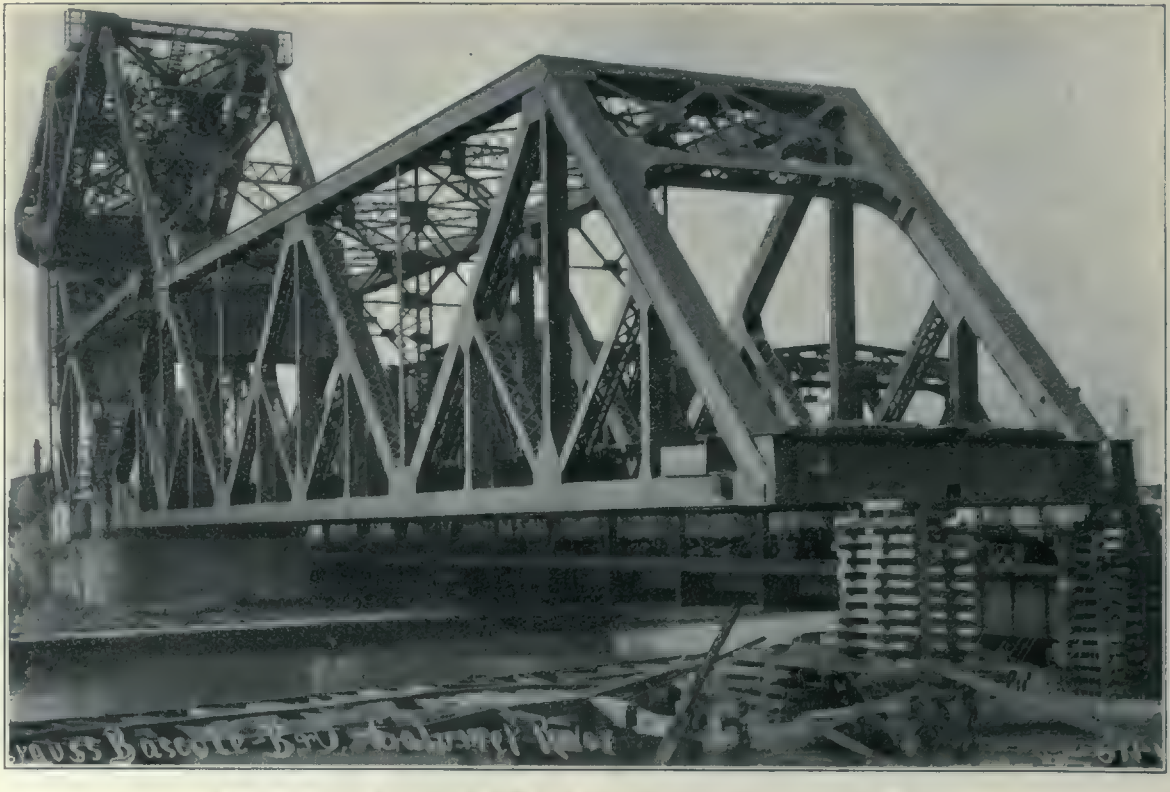


Fig. 15—Bascule bridge for B. & O. R. R. over the Calumet River at South Chicago.

avenue, Vancouver, B.C., is of this type, and was designed by Waddell and Harrington.

The crossing over the Oswego Canal at North Salina street, Syracuse, N.Y., presented unusual conditions. The street crosses the channel at an acute angle so that if the bridge, which is a single leaf bascule, had been placed with the bascule girder parallel to the centre line of the street the span would have been excessive for the required width of channel. In the design used the bascule girders were placed normal to the channel as shown in Fig. 11. A cross girder is framed across the front end of the two bascule girders and cantilevered out to carry the triangular section of the floor to the left. A similar girder extends to the right near the trunnion to carry a similar section of the floor. These cantilevered girders, however, carry only the dead load, as pedestals are provided to support them at various points when the bridge is closed. The bridge was designed by the Bridge Department of the State Engineer's office under Mr. Wm. R. Davis, chief bridge designer. It was opened to traffic in 1908.

Figure 12 is a schematic drawing showing the principles of the various types of what are known as Strauss bascule bridges. While there are many modifications of the Strauss bascule bridges, they all belong to some one of the three types shown and known as "heel trunnion," "overhead counterweight," and "underneath counterweight." For all three types the counterweight is connected to the moving leaf by means of a parallelogram whose sides are steel members hinged at the intersection point. The use of this

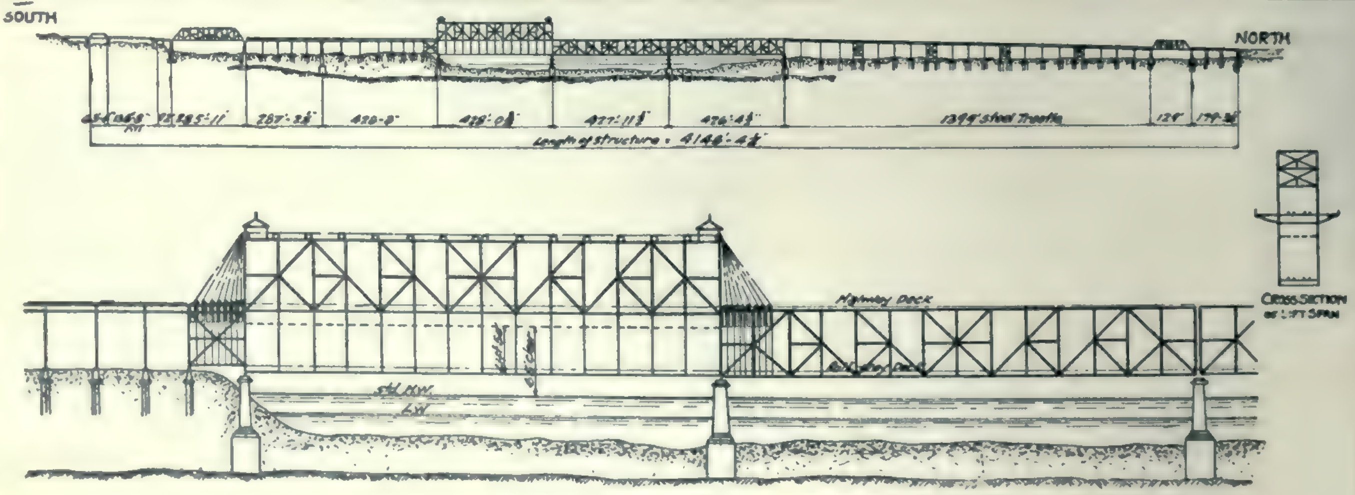


Fig. 16—Vertical lift bridge over Missouri River at Kansas City, Mo.

parallelogram eliminates the necessity of having the centre of gravity of the counterweight on a line through the centre of gravity of the moving leaf and the centre of the trunnion. This makes it possible to locate the counterweight where it will not interfere with traffic or other parts of the structure. All three of these types of bridges are balanced in all positions and, for all of them, the dead load pier reactions are always vertical and remain constant through the movement of the bridge. These bridges are designed by the Strauss Bascule Bridge Company, of Chicago. The first Strauss bridge to be built is the one which carries the Wheeling and Lake Erie R. R. over the Cuyahoga River at Cleveland, Ohio. It is of the overhead counterweight type. The moving leaf is hinged at the main trunnion at a point nearly in line with the bottom chord of the truss. The counterweight is supported on a steel frame pivoted to the tail end of the bascule truss at the lower end and pivoted to a link at the upper end. This link which is pivoted to the tower prevents the counterweight from tipping. The main trunnion and the counterweight trunnion are on a line passing through the centre of gravity of the moving leaf and when combined with the two link pins form a parallelogram. The inside trunnion bearing is supported on a cross girder which passes through the bascule truss whose members are so placed that the cross girder does not interfere with the truss as the bridge is opened. This bridge was opened for traffic October 14, 1905. A later form of the overhead counterweight type is shown in Fig. 13. This bridge was built for the Boston & Maine R. R. at Manchester. The counterweight frame is vertical and both the inside and outside trunnion bearings are carried on steel columns which rest directly upon the masonry. It was completed during the summer of 1911.

What is known as Knippel's Bridge, Copenhagen, Denmark, is of the overhead counterweight type. Large monumental towers which enclose the counterweights and provide operator's houses give the bridge a very pleasing appearance. The bridge has two leaves which when closed rest on pins so located as to enable them to act together as a three-hinge arch to carry the live load. This bridge was completed in 1909.

Fig. 14 shows the new Strauss double leaf heel trunnion bridge which carries the track of the Canadian Pacific Railway over the U. S. Ship Canal at Sault Ste. Marie, Mich. Each leaf is pivoted on a trunnion nearly in line with the lower chord. The counterweight is supported on a pair of trusses which are pivoted on the top of a tower. The front ends of the counterweight trusses are connected to the moving leaf by means of a pair of links pivoted at each end. The main trunnion, counterweight trunnion and the two link pins form a parallelogram. By having the centre of gravity of the counterweight on a line through the centre of the counterweight trunnion, parallel to a line through the centre of the main trunnion and the centre of gravity of the moving leaf, the bridge is balanced in all positions. This bridge is of special interest because of the fact that it is the only double leaf heel trunnion bridge which the Strauss Bascule Bridge Company have designed and because of the fact that, as far as the writer is aware, it is the only double leaf bridge which has ever been built for which a moment lock is provided at the centre. A compression and shear lock is provided at the centre of the top chord and a tension lock is provided at the centre of the bottom chord. These locks enable the section at the centre of the bridge to act together as a simple span to support the live load. The distance centre to centre of trunnions is 336 ft.

Figure 15 shows the Strauss heel trunnion bridge which is to carry the B. & O. R. R. over the Calumet River at South Chicago. It is a double track bridge and is claimed to be the longest single leaf bascule in the world. The length, centre to centre, of supports is 235 ft. The moving leaf is completed and was closed in the spring of 1913 but has not been put in service because other track changes are yet to be made.

Dr. J. A. L. Waddell has designed a number of the more recent vertical lift bridges. The first one built after his design is at South Halsted street, Chicago. Steel cables fastened to the four corners of the lift span pass over large wheels supported on towers at the ends of the span. Counterweights supported on these cables balance the lift span. While the bridge is moving it is held in place by guides on the tower. The lift span is 130 ft. long and has a vertical motion of 142 ft. 6 in., giving a clear head room when open of 155 ft.

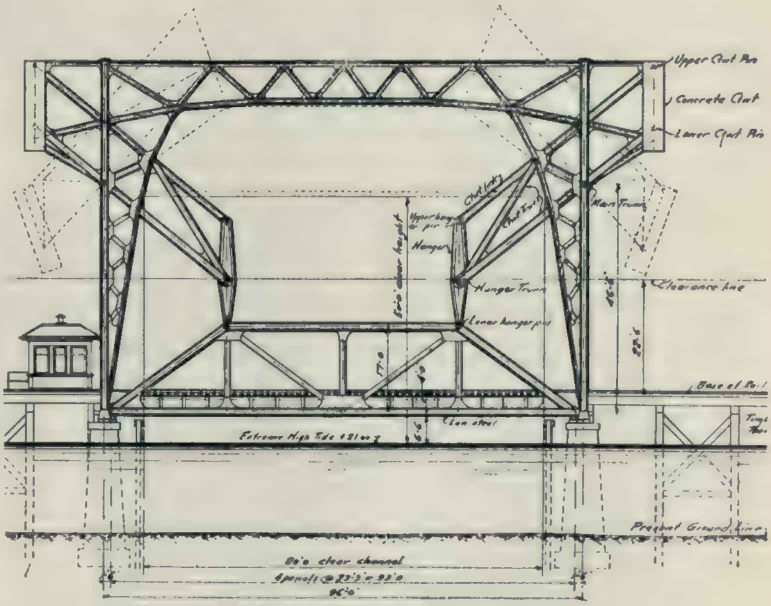


Fig. 17—Vertical lift bridge at Tacoma, Wash.

Figure 16 shows the vertical lift span of the bridge over the Missouri River at Kansas City. The structure, which is double deck, carries a railroad on the lower deck and a highway on the upper deck. The lower deck which is suspended from the upper deck by means of rods can be raised by telescoping the rods into the posts of the upper truss. The upper truss is fixed. The lower deck has a vertical movement of 50 ft., which gives a minimum clear head room of 65 ft. above standard high water. This bridge is of additional interest because of the length of span which is 428 ft., providing a clear channel of 413 ft., which is the widest provided by any movable bridge in the world. The double deck vertical lift bridge at Willamette River at Portland, Oregon, has a lower deck which can be raised by telescoping the suspension rods which support it, into the vertical posts of the upper deck so as to provide for the passage of ordinary boats. To provide for the passage of tall-masted vessels, after the lower deck has been raised until it comes nearly up to the upper deck, the two are lifted together so as to provide an underneath clearance of 140 ft. above high water. The two decks are counterbalanced independent of each other. Both of these bridges were designed by Waddell and Harrington, Consulting Engineers of Kansas City.

Figure 17 shows a type of vertical lift bridge which is of recent invention. Near each end the top chord of the lift span is hinged to the lower end of a hanger. A pivot near the centre of the hanger connects it to the end of a truss which is supported near the centre of its bottom chord by means of a trunnion carried on the top of a tower. A counterweight is pivoted to the opposite end of the truss. A pivoted link connects the top of the hanger and the top of the counterweight. As the lift span is raised the lower hanger pin moves in a vertical line and the hanger trunnion moves in a circle about the main trunnion as a centre. This inclines the hanger and since the hanger link, counterweight, and bottom chord of the counterweight truss form a parallelogram, the counterweight is inclined an equal amount. The weight of the lift span hanging from the lower end of the hanger tends to make it return to the vertical position. This tends to put compression in the link. At the same time the counterweight being inclined it tends to fall toward the channel and also tends to put compression in the link. By properly proportioning the weights and dimensions the action of the counterweight can be made to exactly balance the action of the weight of the moving leaf. For the bridge to be properly balanced, not only must the moment of the counterweight about the lower counterweight pin be equal and opposite to the moment of the moving leaf about the hanger trunnion but their moments about the main trunnion must also balance. To effect this latter balancing a second or auxiliary counterweight is provided which is rigidly attached to the counterweight truss just below the pivoted counterweight. The bridge shown in the figure was designed by the Strauss Bascule Bridge Company for the Northern Pacific R. R. over Steilacoom Creek at Tacoma, Washington.

No bridges of this type have been built, but a number of them have been contracted for during the last year and a half.

Figure 18 shows a type of vertical lift bridge developed by the Strobel Steel Construction Company. With this bridge the weight of the moving leaf is counterbalanced by a counterweight on the outer end of a truss which rocks over the top of a tower. For the bridge shown in the left of the figure, pivot C is supported on rollers which move back and forth as is necessary while the point B moves in a vertical line. For the bridge shown in the right of the figure the corresponding horizontal motion is provided by means of a roller at G.

A ten-foot concrete-lined steel pipe recently built in Baltimore to deliver water from the Loch Raven reservoir to the Loch Raven-Montebello tunnel at a point just below its gate house is described by Ezra B. Whitman, president of the Water Board, in the monthly journal of the Engineers' Club of Baltimore. It was estimated that this pipe could be constructed and that the relining of 1 mile of the old 12-ft. tunnel could be done for an estimated cost of about $300,000, as compared with the estimated cost of $480,000 for a new 12-ft. tunnel 6,340 ft. long joining the old tunnel 1 mile below its upper end. The pipe is made in alternate inside and outside telescoping lengths 15 ft. long and of 10-ft. minimum inside diameter. Changes in grade and alignment are made by beveling the ends of the section. The pipe is made of soft open-hearth rivet steel intended to have sufficient ductility to stretch rather than crack in case of unusual strain from water hammer or settlement. The metal is 7-16 in. thick, although a thickness of less than ¼ in. would theoretically suffice for the stress developed. The pipe is supported on concrete cradles intermediate between the riveted joints and having a radius slightly greater than that of the pipe surface.

A blueprinting machine that makes prints from 2 ins. to 48 ins. wide and of any length, and which occupies a floor space of 2½ ft. by 5 ft., has just been placed on the American market. The work, according to a note in the Engineering Record, can be carried out in a lighted room, as both the unprinted paper and the finished prints are kept in light-proof compartments. The tracings and paper are fed into the machine on an endless, automatically tightened belt operated by an electric motor. They then pass around the printing cylinder, which consists of spirally disposed bronze wires so arranged that the paper and tracings are kept perfectly smooth while passing around. Inside the cylinder is a mercury vapour lamp, which is said to be a very desirable source of light for blueprinting, as it is rich in chemical rays, with actinic powers particularly adapted for this work.

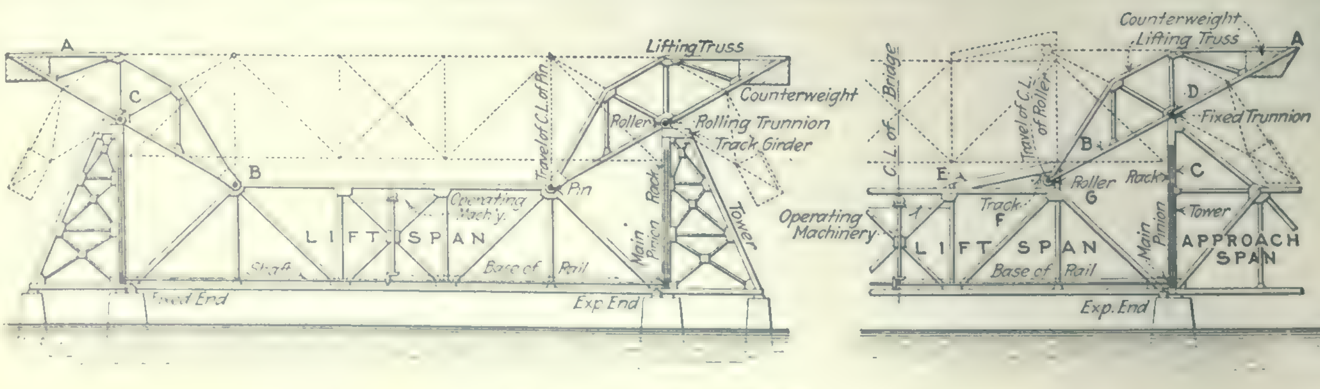


Fig. 18 - Lift bridge at La Salle, Ill.

Conscience in Municipal Engineering*

Awakening Betokened by the Observance of a Code of Ethics—The Fundamental Requirements of the Civic Official

CONSCIENCE may be defined as an inherited tendency towards righteousness. It may remain dormant, but, fortunately, the majority of the individuals who constitute the "mass of humanity," possess this potential righteousness, and its awakening at some period during the career of the individual is probable.

The awakening of conscience is betokened by the assumption, the introduction and the subsequent practice, with more or less consistency, of a code of morals. This code is, however, practiced in two distinct manners. The majority are content to practice it conservatively and at home, avoiding carefully all temptation to violate it and succeeding admirably in adhering to well formulated principles without in the least disturbing the equanimity of their less moral neighbors and without, in any way, entering into the general conflict against the common evils which confront the race. Those of the other class, still in the minority, unfortunately, practice their codes openly, aggressively and with initiative. These are the leaders in the movements toward betterment in all walks of life and the achievements of a number of them whose activities are directed towards the public welfare, in what is commonly known as civic betterment, are of vast importance to the progress of civilization.

Coming to the point, we may take New York as the scene of the strife for civic betterment and may consider the municipal engineer in his attitude towards it. One does not have to delve into remote history to reveal this person in the guise of a moral tadpole. It is within the memory of living man, when he wiggled about in the pool of civic stagnation, hoping for the day when, as an active moral frog, he might jump to the bank and view the sunlight. The day has arrived and while the sunlight may, perhaps, at times, be obscured by a passing cloud, it is true that the tadpoles are developing hourly and are emerging in new form from the depths of the dark pool. Having seen the sunlight, it is the impulse of those whose lot has been cast in the pool, to go back and clarify it.

We are thus daily increasing the numbers of those who are aggressively following their code of morals. We are passing the time in which we were content to tolerate on the part of others what we considered improper for ourselves. We are unwilling to yield to those who will not see the sunlight and we are going to bring them into it or destroy them.

The latter day practice in municipal engineering has developed with some and has been forced upon others on the theory that each man must show his hand, he must work in the open, and the barrier of mystery in which the incompetent surrounded himself to conceal his incompetence, and with which the competent surrounded himself for protection against the incompetent, is destroyed. The "one-man policy" in which the person in a position of advantage acquires and holds information essential to the proper conduct of a piece of work, thereby making himself indispensable, is becoming obsolete. Engineers find that their positions are more secure and more important when they are understood than when their work is shrouded in mystery. It is no longer expedient to cover one's tracks in order to conceal possible errors. It is far more profitable to acknowledge and correct them. The executive engineer who exposes and reports his own mistakes as well as those of his subordinates gains the confidence of his superior officers and the respect of his subordinates. If his mistakes are too numerous to be tolerated, the old style concealment will not avail, for, as it has been said, the new idea is being forced upon those who do not adopt it voluntarily.

It frequently happens that specifications are incomplete, that some item of importance is omitted, or that some unexpected obstacle is encountered in the execution of the work which the contractor refuses to correct or overcome, without extra compensation. It has been known that such difficulties have been adjusted by an arrangement between the engineer and contractor, whereby the latter would be released from some less important obligation in compensation for his performance of the additional work. While these bargains were almost invariably made on the "dollar for dollar" basis and were usually of benefit to the work, it is within the scope of imagination to conceive of cases in which the bargain was made rather to conceal errors than to correct them. When, however, the work must be publicly reported in detail, or when the work is executed by an engineer who is beyond the control of the one who drew the specifications, the latter is required for his own protection to develop more carefully the details of his work so that corrections in the field will not be necessary.

Another abuse which has been abated by publicity is the ancient system of continuing work until the appropriation, far too large originally, became exhausted. It has happened that work has been extended and modified repeatedly until the ultimate creation was far in advance of the original and the funds still showed a balance. The process was similar to the plan pursued by the suburban homesteader who purchases a gallon of paint to cover the kitchen porch and finding a large balance on hand after having completed it, proceeds to paint the back fence and the barn doors. With specific appropriations based upon itemized estimates, carefully analyzed, there is no balance remaining after the completion of the work, and therefore its indefinite extension is not possible. Again the preparation of the specification and the estimate must be more careful for "extras" cannot be met within the appropriation.

There is another phase of municipal work which has undergone a change in recent years, and that is the relation between the executive engineer and his subordinate. The former is rapidly realizing that the errors of the latter will be revealed in the day to day "exposures." It is unprofitable to protect an incompetent subordinate for political or personal reasons, because the incompetence of the subordinate will be accredited to the superior who attempts to conceal or correct poor work.

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*By Alfred Williamson (Mechanical Engineer, Department of Water Supply, Gas and Electricity, New York City) in Municipal Engineering.

Ability is a comparative term and it fails to express all the qualifications which the latter day engineer must possess. Yesterday a man was judged alone on his ability and promptness. To-day he must be capable, prompt and efficient. We have a new dimension to consider, the unit of which is the dollar. In order to measure up to the new standard, a man must possess all three dimensions, the product of which is competence. The new idea then of competence includes ability, which is largely built on experience, it includes promptness which means energy, and it includes efficiency which means study. To be efficient one must recognize the errors made by himself and others and studiously avoid both. Someone has said that efficiency is common sense; it is more than common sense, it is insight.

The improved definition of competence, as set forth above, is to-day the test which every engineer must meet. He may possess one of the elements in larger measure than the other two, but he must possess some amount of all three and the executive engineer must possess even more than this newer competence; he must possess conscience, the active aggressive kind of conscience which influences other men. He must be one of the frogs already on the bank, one of the fellows who have seen the sunlight.

Again, he must possess courage, for conscience without courage is not a valuable asset. He must possess courage which will prompt him to go back into the pool and clean it. Taking then this alliterative trio, competence, conscience and courage as basic ingredients, we may mold a man of worth as an engineering executive.

The optimist believes that such men are already with us, men possessing the basic principles of leadership, and he believes there are a few who also occasionally reveal higher human attributes even than these, such as sympathy, fellowship and kindness, all of which are defined as consideration and all of which result, or at any rate develop from association with wholesome and cultured beings. As time advances, there will be more engineers, civic and private, who possess competence, conscience, courage and consideration.

A Contractor's Cost Account System

By C. E. Anderson

THE cost account system of an engineering and contracting company of Poughkeepsie, N.Y., is a good example of a concise method of keeping track of the cost of work under way. It enables the contractor to tell almost at a glance how much a particular job has cost him at a certain time, and also provides a permanent record to refer to at any future time as may be necessary.

The first step in the record of the job is the daily report made out by the foreman, superintendent or whoever is in charge of the work. A time book is kept, and from this the daily report is made out, showing location of job, contract number, date, classification of workmen, number of men of each classification working, number of hours worked, rate, amount, material used, to whom charged, material received, description of work. There are also columns opposite the time of the men, showing subnumbers.

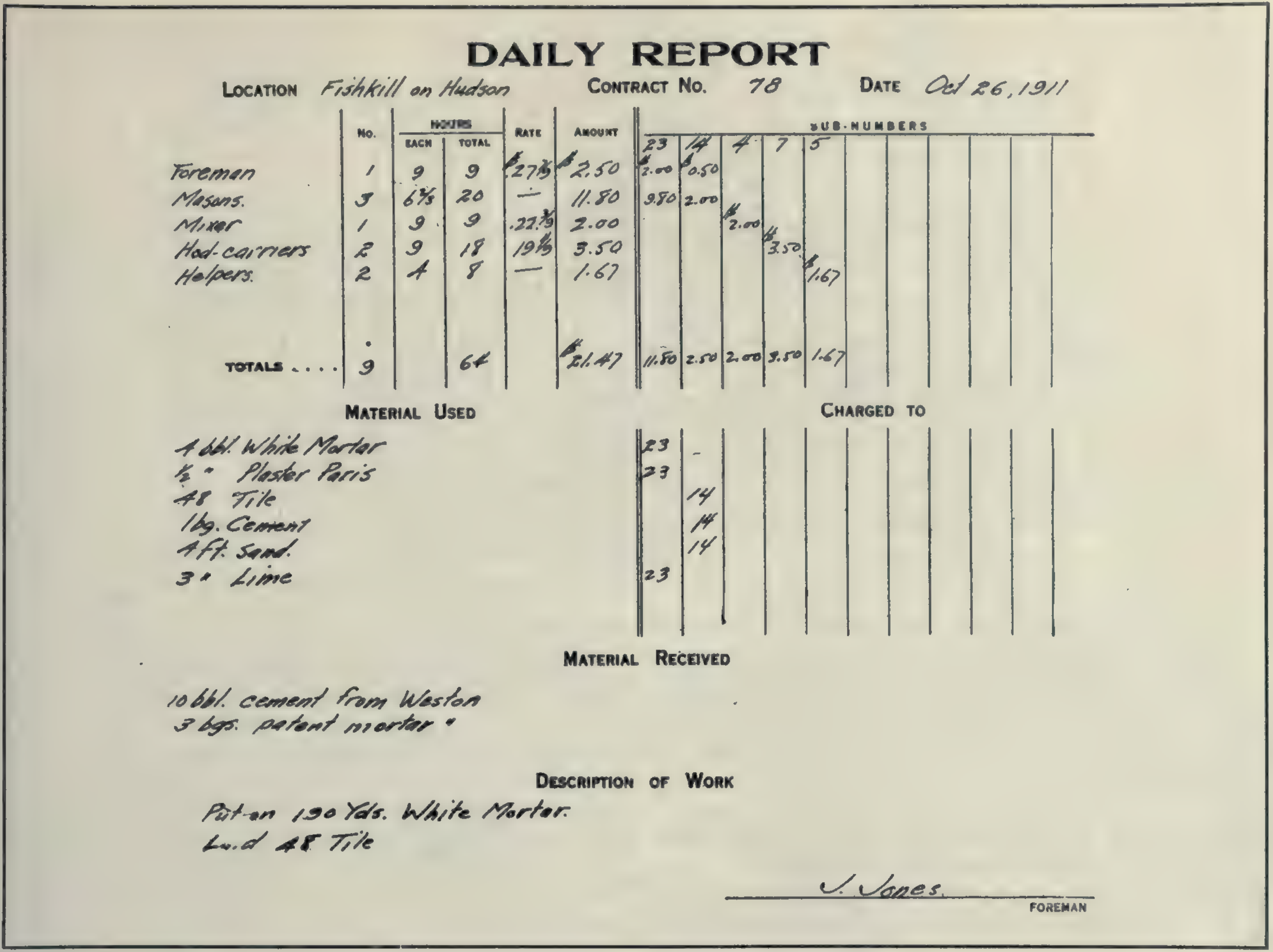
The subnumbers refer to the class or kind of work each man or group of men is doing. For instance, 1 denotes excavating, 1A rock excavation, 1B wet excavation, 2 foundation stone, 3 carrying water, 4 mixing mortar, 5 helpers, 6 hauling material, 7 carrying hod, 8 pointing walls, 9 laying brick, 10 working after plumber, 11 screening gravel, and so on, each operation having a number. By looking at the reports for the job it is evident at a glance just how many men worked each day, what was done by each man or group or class of men, how much they cost, how much material was used, whom or what charged to, and how much material was received.

When these reports are received in the office the data is tabulated. The reports for each job are placed on a letter file, which is hung in its place under its job number. In a journal is placed a daily record of material received, whom or what charged to, and cost. In the ledger are placed under job numbers and dated the total cost of labor, material used, cost and whom or what charged to, material received and whom or what charged to. On the opposite page is tabulated the credit, or material removed or not to be used on the job. At stated times the ledger is balanced and shows cost to date.

At intervals of a week, two weeks, or a month, depending on the size of the job, a balance sheet is filled out, showing the cost of each subnumber, or, in other words, the cost to date of each item of the estimate. Each item in the estimate, being represented by a subnumber, a form is prepared having a vertical column for subnumbers in the same order as shown in the original estimate. Across the page opposite these subnumbers are placed the daily cost of each subnumber or item. At the right-hand side of the page are two columns, one for the estimated cost of the subnumber and the other for the total cost of each subnumber to date. As each subnumber is completed its total cost shows up alongside of the estimated cost, showing immediately whether the cost of the item is smaller or greater than originally estimated. This system has been in successful operation for about three years.

In a small filing cabinet having twelve small drawers 4½ x 4½ x 10 inches, are kept copies of contracts, insurance policies, office help records, bills rendered, bills received, receipts and other papers which it is necessary to refer to from time to time in connection with the contracts. Each drawer is designated according to the contract number.

In letter file boxes are kept correspondence relating to contracts, filed under contract numbers. Bills and statements are filed in a separate box for each contract. On the outside of boxes containing correspondence is marked the dates between which the correspondence runs. Each box is labelled with the



DAILY REPORT

LOCATION *Fishkill on Hudson* CONTRACT NO. *78* DATE *Oct 26, 1911*

	No.	Hours Each	Hours Total	Rate	Amount	Sub-Numbers 23	14	4	7	5
Foreman	1	9	9	$.27 7/9	$2.50	$2.00	$0.50			
Masons.	3	6⅔	20	—	11.80	9.80	2.00			
Mixer	1	9	9	.22 2/9	2.00			$2.00		
Hod-carriers	2	9	18	19 4/9	3.50				$3.50	
Helpers.	2	4	8	—	1.67					$1.67
TOTALS	9		64		$21.47	11.80	2.50	2.00	3.50	1.67

Material Used	Charged To	
4 bbl. White Mortar	23	-
½ " Plaster Paris	23	
48 Tile		14
1 bg. Cement		14
4 ft. Sand.		14
3 " Lime	23	

MATERIAL RECEIVED

10 bbl. cement from Weston
3 bgs. patent mortar "

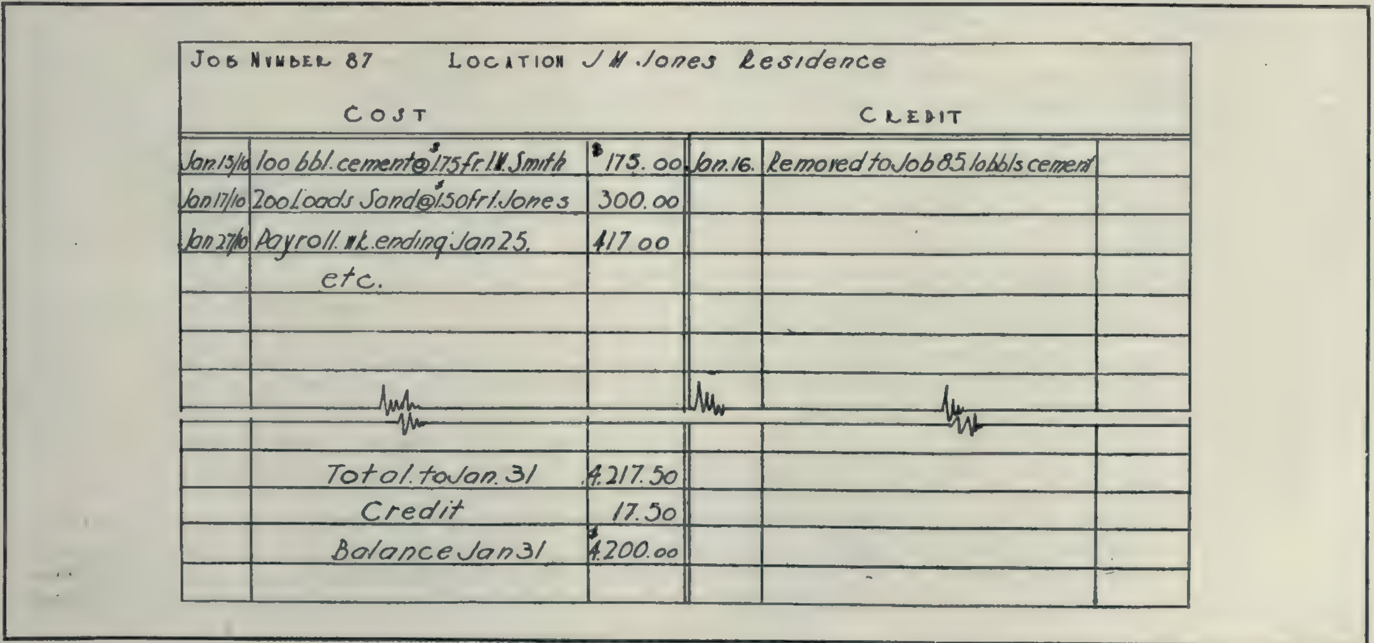
DESCRIPTION OF WORK

Put on 130 Yds. White Mortar.
Laid 48 Tile

J. Jones.
FOREMAN

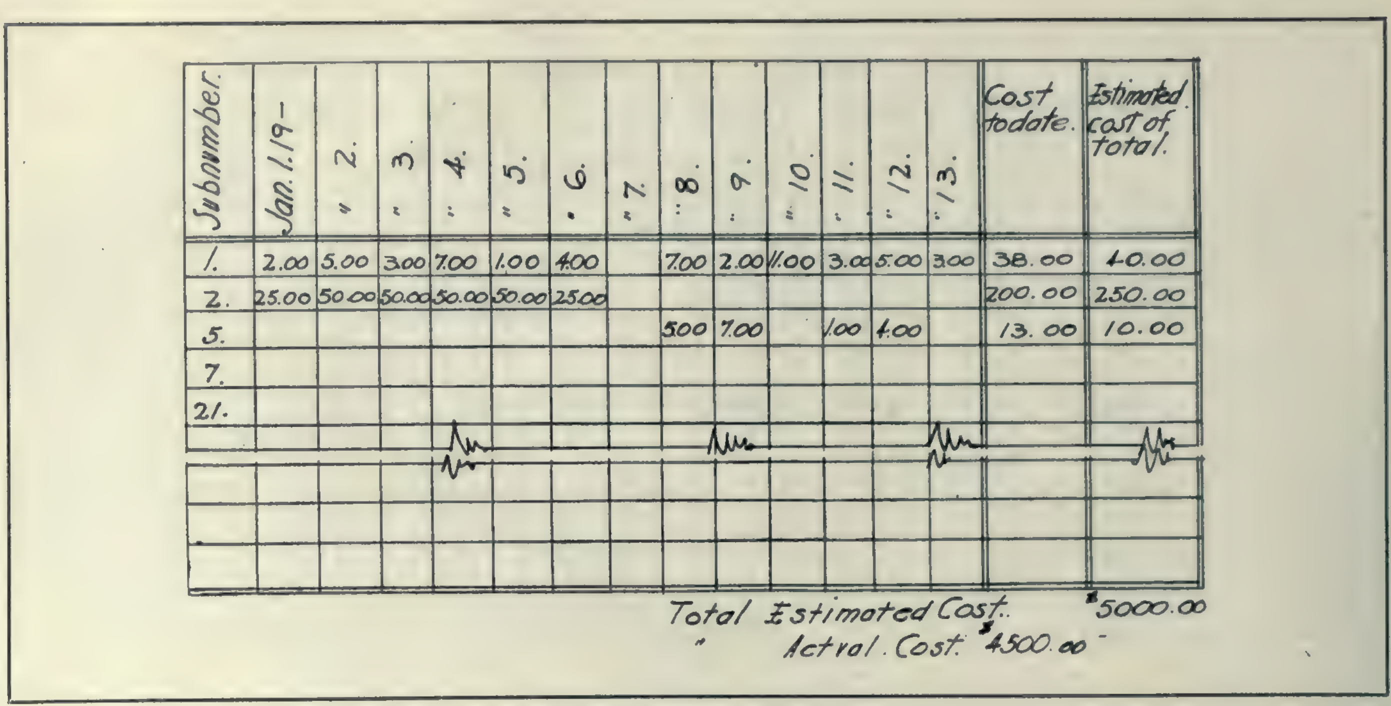
number and name of the contract to which the matter in it refers. Boxes other than correspondence are labelled receipted bills, receipted bills previous to January 1, 1910, receipts, quotations, orders, bills due opened January 1, 1910, estimates. Each box contains an alphabetical file, between the pages of which can be placed at the proper letter the correspondence, bill, estimate, or whatever is to be filed at that letter. By looking at the backs of the boxes one finds the date, classification, or number of the manuscript for which he is looking, and in the box he finds it between the pages of the alphabetical index at the letter of filing.

By these methods all procedure is kept track of,



JOB NUMBER 87 LOCATION *J. H. Jones Residence*

Cost			Credit		
Jan 13/10	*100 bbl. cement @ $1.75 fr. I. W. Smith*	$175.00	*Jan. 16.*	*Removed to Job 85 10 bbls cement*	
Jan 17/10	*200 Loads Sand @ $1.50 fr. I. Jones*	300.00			
Jan 27/10	*Payroll. wk. ending Jan 25.*	417.00			
	etc.				
	Total to Jan. 31	4217.50			
	Credit	17.50			
	Balance Jan 31	$4200.00			



Subnumber.	Jan. 1.19–	" 2.	" 3.	" 4.	" 5.	" 6.	" 7.	" 8.	" 9.	" 10.	" 11.	" 12.	" 13.	Cost todate.	Estimated. cost of total.
1.	2.00	5.00	3.00	7.00	1.00	4.00		7.00	2.00	11.00	3.00	5.00	3.00	38.00	40.00
2.	25.00	50.00	50.00	50.00	50.00	25.00								200.00	250.00
5.								5.00	7.00		1.00	4.00		13.00	10.00
7.															
21.															

Total Estimated Cost. $5000.00
" Actual. Cost. $4500.00

all costs recorded and all other useful data preserved, so that by looking into the ledger or files it is possible at any time to tell what the job has cost to date, or what any previous job cost or any of its items.—The National Builder.

New Types of Country Road Surfaces and the Bad Weather Factor

FORMERLY, perhaps the most variable and troublesome element of risk in estimating the cost of building hard surfaced country roads was the difficulty of determining with any degree of accuracy the effect of weather conditions on lost time, says Engineering and Contracting, editorially. In building gravel and macadam roads the experienced contractor estimates no item more liberally than the item of lost time due to bad weather.

New types of pavements, however, which are coming into vogue are reducing the importance of this factor. Brick and concrete roads and bituminous surfaces on a concrete base are essentially rigid types of construction. When the base is in place construction may proceed with but little regard to the weather. Asphaltic concrete may be laid in comparatively damp weather. Brick surfacing may be laid under similar climatic conditions, provided the sand cushion is not placed too far in advance of brick laying. Ordinarily a damp subgrade is desirable in the construction of either concrete surfacing or concrete base.

Moreover, the percentage of labor cost to total cost has been materially reduced by the increased use of relatively more expensive materials. This condition undoubtedly leads to more accurate estimating, since the cost of materials is a much more stable factor than the factor of labor expense. The importance of the foregoing is self-evident.

The adaptability of the plant required for brick and concrete road building to other quite different uses and its consequent increased salvage value is worth considering. Road rollers and stone crushers are of use only in road construction. Concrete mixers, wagons and motor trucks are used for many other purposes.

There is no question but that more plant and more expensive plant is required in the construction of these higher types of surfaces. A careful analysis, however, will show that the ratio of plant expense to total is no greater on construction at $9,000 to $15,000 per mile than on construction that costs at the rate of $1,000 to $5,000 per mile. Moreover, the reduction in cheap labor expense which is generally effected by the use of machinery, permits the employment of a much more reliable class of labor, although the rate of wage may be higher.

Country and suburban road construction is rapidly becoming an inviting field for the large contractor. Equipment requirements for building relatively higher types of surfaces are beyond the credit and capital of the small contractor. And yet with this change the opportunities for the contractor of limited means to secure sub-contracts for grading or hauling are increasing and much work will undoubtedly be handled in this manner in the future.

These conditions are doubtless familiar to all engineers and contractors actively engaged in road building. But changes have come about so rapidly and are to-day taking place so fast that even the specialist in this work, strive as he may to keep posted by assiduous reading and observation, is apt to fall behind. Also a vast number of men engaged in other lines of work still cling to the accepted notions of ten years ago, although developments of recent years have materially changed old methods and types of construction.

The influence of the use of new materials on the old variable of lost time will be felt. The lost time factor is still important but instead of being almost entirely dependent on bad weather, other factors such as delayed shipments, breakdowns of machinery, and strikes must be considered, which factors formerly were of relatively small importance..

A clean, sharp, thoroughly dried silica sand or crushed quartz should be used for sand-blasting, and for use with a ¼-in. nozzle the sand should be screened through a No. 8 screen, and through a No. 12 when a ⅛-in. nozzle is used.

Practical Points in Modern Road Work[*]

The Planning of New Routes—Improvement of Existing Roads — Tar and Tar-Painting — Repairs — Mechanical Haulage

By W. H. Maxwell, A. M. Inst. C. E.†

IN the planning of new routes, directness of line is usually an important feature to be considered, from an engineering and utilitarian point of view, but leads to monotony in the use of the road. As a general rule, it will be more advantageous to carry a new through route past the outskirts of a town, and connect up with some good branch road to the urban area, rather than attempt to carry the new main thoroughfare through the heart of a populated centre, as the difficulties and costs of widening existing narrow roads through built-up areas are necessarily excessive, owing to the property and business interests disturbed. Very wide roads are not favored by shopkeepers, as they are not conducive to good trade—the bulk of pedestrian traffic usually keeping to one side of such a road.

Curves on a new main road should, of course, be as easy as circumstances will permit, but a radius of 100 ft. should be the minimum where fast through traffic is to be accommodated. On this curve, a person travelling along the centre line of a clear 40-ft. roadway could see approaching traffic within the limits of the road-width about 120 ft. ahead. Under similar conditions, with a 150-ft. curve, a distance of about 150 ft. ahead could be seen. On rural roads, traffic invariably uses the centre of the road by preference, and modern high speeds render an ample, unobstructed view essential.

The easing of curves invariably quickens the speed and reduces that degree of commendable caution in drivers which formerly existed. On a sharp curve the motorist is bound materially to reduce his speed or perish.

Curves should in all cases be freed from side sight-blocking obstructions, and for increased safety to fast traffic the road surface on the outside curve should be given a suitable degree of super elevation.

Dead-level roads are to be avoided. If the longitudinal inclination is less than about 1 in 100, the surface water will be difficult to drain away, and more cross-camber must be provided. With a longitudinal gradient of 1 in 50, or sharper, the camber may be flattened considerably, as the needful surface drainage is obtained longitudinally. This flattening of cross-section should not, however, be carried too far, otherwise watercourses will speedily form down the centre of the roadway on steep gradients.

Suitable cambers for different surfaces under ordinary conditions are: Granite macadam, 1 in 25; tar-macadam, 1 in 30, or 1 in 40 on incline; creosoted deal paving, 1 in 36; hard wood and granite, 1 in 45; and asphalt paving, 1 in 50. The longitudinal fall of water channels should not be less than 1 in 100 for a granite channel, and 1 in 150 for asphalt.

Improvement of Existing Roads

Inadequate Foundations.—The majority of the old highways of this country have come into existence in a more or less haphazard fashion, and in the past the provision made for their maintenance has been uncertain and inadequate. The entire absence of foundations suitable for carrying modern weights brought upon the surface is revealed by the upward movement of the sides of the roadway into the channels—a weakness to be observed generally throughout the country.

Vast sums are now being spent in laying down expensive so-called waterproof surface crusts of various kinds, in order to give an immediate show for the money expended, but the writer is of opinion that wherever there is evidence of underlying weakness money may be more advantageously applied by first putting in proper foundations and drainage. However excellent, well laid or expensive may be the surfacing material, it can never prove really satisfactory on a weak foundation. There will be gradual but constant movement of the road crust, local sinkages of the central portion and rising of the sides, and generally the annual expense of wear and tear of the surface will be greatly enhanced in cases where no solid and unyielding foundation exists.

Thin Crusts.—The wisdom of recent practice in laying thin surface wearing crusts or armourings of asphalt and bituminous preparations over existing macadam surfaces is open to great question, except where an absolutely rigid and dry foundation can be relied upon. In the absence of this, most ordinary road surfaces are subjected to considerable movement under modern speeds and weights, and in these circumstances thin wearing crusts are liable to fracture and disintegrate. Great caution in the selection of a suitable site is necessary, except where laid on a good concrete foundation, which, unfortunately, in most cases, would make the cost of the work prohibitive.

Bituminous Methods.—In what are known under the general name of "bituminous methods" the presence of coal-tar and pitch is the distinguishing feature, and the main object of all such processes is to exclude water from the crust of the road. These methods consist mainly in the revival and extended use of tar-macadam, pitch-grouting, tar-binders, and other like forms, and in suitable situations and conditions give very serviceable surfaces at a not unreasonable cost, but much discrimination is needed in their application.

The arch enemy of the tar-macadam road is the traction engine, and this cumbersome, vexatious contrivance is, unfortunately, rather in evidence in the writer's district, especially during the spring and early summer months. These engines, with destructive diagonal steel strips on the wheels, weigh over 16 tons on the road, and haul three lumbering wagons weighing about 12 tons each when loaded. Under this burden the very best of tar-macadam work suffers substantial damage. Even after having been laid many months the material, owing to its plastic nature, will slightly soften on a hot day, sufficient to permit of its being crushed out of shape and torn up under traffic of the class named.

A well-made granite macadam road surface withstands this class of traffic very much better than tar-macadam, or any of the bituminous processes.

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[*] Abstract of paper read at annual meeting of the Institution of Municipal and County Engineers at Cheltenham, Eng.

†Borough Engineer, Tunbridge Wells.

To the enthusiast for tar-macadam, in addition to the above caution, the writer suggests that consideration of the following points will help to keep him out of trouble:—

(1) The quality of tar available for such work is very variable and unreliable, and requires constant watching to avoid failure.

(2) Good fine weather is an important factor for successful work. If the weather is too cold there is great risk of too much tar being used, thus causing the tar-macadam to become very soft and easily damaged during the warm weather.

(3) Tar-macadam is hopeless on a weak, yielding foundation.

(4) It cannot be satisfactorily repaired during wet, cold weather. This is important in streets where much opening of trenches for gas, water, electric and other services is likely to be required.

(5) Where there is much traffic a continual watch must be kept on the work for some time after it has been completed, which considerably adds to its cost.

(6) Tar-macadam is liable to "creep" during hot weather towards the sides of the roads, especially in country districts, where the lateral support of a kerb and footpath is not usually available, and some provision to meet this tendency should be made.

(7) The cost of tar-macadam is, as a rule, much beyond that of a granite macadam tar-painted surface, and its serviceable life cannot always be so accurately predicted.

The foregoing matters are mentioned, not with any desire to discourage the use of this type of road surface, but simply with the object of drawing attention to a few points which require consideration to ensure successful work.

With regard to the pitch-grouting of road macadam, the writer is of opinion that this process has not yet been proved to be so satisfactory under like conditions of traffic as good-class tar-macadam well laid. The work is expensive, its serviceable life is not great, the surface soon becomes deeply corrugated, and carries much slippery mud during wet weather.

Coatings of tar-macadam of a total thickness of 4½ ins. are sometimes laid with a layer of coarse material at the bottom, and finished with a fine grade for the surface. A coating of the thickness named is best laid in two layers, but there is no advantage in separating the fine and coarse grades; the same mixed grade material should be used for both coats.

Rolling of tar-macadam is best done with a light steam roller (6 or 7 tons weight), and there is nothing to be gained by an excessive amount of rolling.

Tar-macadam may be laid on gradients as steep as about 1 in 25, and even sharper if the surface is kept clean. The degree of slipperiness experienced depends greatly on the weather and the skill of the driver.

It is a great mistake to lay-tar-macadam or any other bituminous road surface over an existing macadam roadway as a foundation without first lightly scarifying the surface all over and consolidating by rolling to a uniform condition before the bituminous material is laid. Where this precaution has been neglected the old inequalities and potholes in the road crust will soon reappear on the surface of the newly laid coat, as the greater depth of bituminous material over the pothole consolidates mode than the thinner coating around.

Tar and Tar-painting.—Experience of recent years has led to the settling down of much preliminary clamour about dust-layers to the very general use of coal-tar. This new demand has brought about a very substantial increase in the price of tar, and, with the continued extension of bituminous methods of road construction, the demand appears likely to exceed the supply, and so set a limit on this form of road improvement unless competitive processes are adopted.

The specially prepared tar for road surface painting used by the writer weighs 12.95 lbs. per gallon, or 173 gallons to the ton. This is heavier than the weights recommended in the Road Board Specifications, but the tar is found to make very satisfactory work.

Tar-painting is not usually very successful on roads with damp, clayey subsoils, in shady situations, or under trees. A dry, sandy or chalky subsoil is the most favorable for the work, and in these areas operations can be started earlier in the season.

The heavy, complicated, costly tarring machines of early tar-painting days have almost disappeared in favour of much simpler plant and hand work, the latter giving the best results in this class of work.

For town work granite chippings ⅜-in. to ⅝-in. gauge make the best class of grit for covering the tar. Sand, though usually much cheaper, produces an increased quantity of mud and causes the tar-painting to tear up more readily under heavy traffic.

Increased attention is necessary on a tarred road to the picking up of horse-droppings and light litter, as these blow about much more readily than on an ordinary macadam road. The writer uses a number of light covered hand-barrows for this purpose on all tarred areas.

In his experience the amount of money spent on road tarring is about equivalent to the saving obtained in ordinary maintenance and wear and tear on the roadways, so that no increase on the total cost of highways arises, while a greatly improved surface is obtained during the summer and autumn months. Tar-painting gives most economical results on secondary roads, culs-de-sac, and other thoroughfares with light traffic, as, in some cases, the tarred surface remains in good condition for several years without repair, and very little attention of any kind is needed.

Repairs.—Systematic inspection of the roadways, and regular and prompt patching of depressions and potholes is very desirable, especially on motor-omnibus routes. For this work the writer uses a light roller of the convertible tractor type, which is well adapted for the purpose.

Under modern traffic conditions the highways require to be regularly patrolled and repaired, much in the same way as a railway track.

Old screened road metal of small gauge is well suited for patching, as it consolidates quickly.

Ordinary macadam surfaces should not be patched with tar-macadam, as, after a little wear, a most unsightly and intolerably bumpy surface results, owing to want of uniformity in wear of the variegated surface.

When recoating a roadway the thoroughfare should be closed wherever possible, and the whole width of road coated and rolled in one operation. Work of this class done in half widths is seldom satisfactory, as rapid wear invariably occurs at the central joint. In cases where this system cannot be avoided it is best, if possible, to first treat about two-thirds of the width, so as to keep the joint out of the centre of the road; but many roadways are too narrow to permit of this being done.

Weather conditions are among the most powerful factors influencing the wear and tear and deterioration of roads. Prolonged rain and heavy traffic following the break-up of frost immediately succeeding a wet period are particularly destructive.

In town streets where a macadam surface has to be renewed about every two years and patched frequently, a wood-paved surface will probably be more advantageous. A maintenance cost of 10d. per square yard per annum is about the economical limit for macadam, and, from the point of view of traffic weight, a load of some 250 tons per yard of width per day is about the maximum for an ordinary macadam surface.

Steam Rollers.—In the opinion of the writer the usual so-called "10-ton" steam roller is much too heavy for the majority of surface recoating work. These rollers, when loaded ready for the road, often weigh nearer 13 to 14 tons than 10, and frequently cause much damage to the new metalling by crushing and weakening it during the process of consolidation. In some cases metal is put on the hard crust of the old road without preliminary scarifying, and rolling down with a heavy steam roller, with the result that the stone, being severely crushed between hard surfaces, is permanently damaged at the outset, and the serviceable life of the new coat thus sadly reduced.

For much of this work the writer uses what is described by the makers as a 7-ton roller of the convertible roller-tractor type already referred to. This machine is found to be of the greatest service for all classes of work as well as for haulage. The small tractor roller can be moved quickly from job to job, and can be converted to a tractor in about a couple of hours. The cost of a first-class machine of this kind, including both roller and tractor gear, would be about £550. This roller, with awning, water, etc., fitted up ready for work on the roads, actually weighs 9.42 tons.

Mechanical Haulage for Municipal Work

Whatever may be the views held as to the desirability of public highway authorities employing steam, petrol, or other motor vehicles for haulage purposes, the writer has been practically compelled to do so on account of the difficulty experienced during the busy spring and summer seasons in procuring sufficient suitable horses. It is usually impracticable to keep, during the relatively quieter winter months, a full stud of horses sufficient to cope with all work during the busier period of the year, and such work as street watering and road tar-painting greatly accentuates the variation between winter and summer haulage demands. The hiring of the surplus summer requirements affords one way out where the horses can be got; but horse contractors are fast changing to mechanical haulage, thus greatly limiting the supply.

Slippery Road Surfaces

In these days of improved road surfaces, tar-painting, tar-macadam and such like, complaints are, perhaps, a little more frequent in respect of slipperiness, and requests for gritting or sanding are often made. The best plan to overcome slipperiness is to keep the surface as clean as possible by removing (and washing off, if necessary) stiff, pasty mud which is liable to accumulate during the foggy, damp weather of the winter months. Griting and sanding greatly increases the production of this stiff, slippery mud, as the material is speedily crushed by the traffic. The application of grit, therefore, should be done as sparingly as possible, and cleansing of the surface should take its place.

Collapse of a Port Arthur, Ont., Wharf

A section of a wharf belonging to the Canadian Northern Railway sank out of sight July 4 under a load of about 2,100 tons of steel rails. The "S. S. McKee" had completed unloading a cargo of rails in the afternoon and had left a short time before the accident occurred. The rails were 80-lb. A. S. C. E. rails, 33 ft. long, and had been placed in three piles, each pile being about 33 x 66 ft., with transverse spaces a few feet wide between piles. The section that failed was about 75 ft. square. Two piles of the rails were carried down with it, each pile containing about 1,050 tons. The entire length of the wharf was loaded with rails, some of the piles weighing 1,200 or more tons. The rails on the portion not wrecked were hastily loaded on cars to save from further loss and to facilitate the salvaging of lost rails.

The wharf, which was about 75 x 450 ft., was constructed in the winter of 1912 and 1913 by the Thunder Bay Harbor Improvement Company under the supervision of the Canadian Northern Railway according to plans and specifications furnished by the railroad. The pier was built similar to the others originally used for unloading steel rails and later was covered and used for package freight as occasion demanded. It is stated that some of these older wharves had supported piles of rails weighing as much as 1,400 tons without sign of failure.

The piles used were sound tamarack from 40 to 50 ft. long, with 12-in. butts, and were driven to hard bottom. The water varied from 12 to 20 ft. in depth. In places the bottom of the lake was covered with several feet of soft mud. No batter piles or sway bracing was used. The piles were spaced about 5 ft. each way and were capped with 12 x 12-in. fir running transversely. The longitudinal stringers were 6 x 10-in. fir spaced 24 in. on centres. The deck is about 8 ft. above the level of the lake. The portion of the wharf which remained standing supported several piles of rails, the edge of one being only a few inches from the rupture. The cause of the accident will probably not be known until after the removal of the wreckage so that the condition of the piling underneath can be investigated. If the rails were properly piled with a skid rail over each cap the piling would have been supporting about 11 tons each.—Engineering Record.

The cement gun is being used to finish the ornamental concrete poles which are being erected on Van Ness Avenue in San Francisco. The poles are for the double purpose of lighting and carrying trolley wires for the new municipal railway. The coating is being applied after the poles are erected, so that the finish will be free from the marks of handling, and the pole proper will seem to be monolithic with the base. After the surface has been sufficiently coated it is immediately trowelled to the desired lines, the aim being to secure a cement coating about 3-16-in. thick. The contract price for the finishing was $26 per pole.

The finish of a concrete surface should be determined before the concrete is placed and the work conducted so as to make possible the finish desired.

The Efficient Operation of Dynamite

Analysis of Action of Blast with Reference to Depth of Spacing of Holes and Amount of Powder for steam Shovel Work.

By Charles E. Anderson, Civil Engineer, New York City.

BLASTING for steam shovel work requires that the rock be shattered into pieces small enough to be handled by the dipper. At the same time the powder man must prevent the rock being thrown into the air to an unnecessary extent, a result calculated not only to do damage but to waste powder. It is true that economy of powder is not always the first consideration on a construction job, but the use of the proper amount of powder, in conjunction with the best depth and burden of the holes, will result in a saving not only in powder, but in drilling and shovelling.

Getting the full efficiency out of dynamite means not only using the least possible powder, but using it in such a way as to cut drilling and "dobe" shots to the minimum. Occurring frequently, as they do on some jobs, "dobes" or mudcaps have come to be considered a necessary evil; it is not every blasting foreman who is willing to admit that the large number of these shots necessary is due to some miscalculation in his blasting methods. These necessitate the stopping of work while the men get to a safe place and many such interruptions mean considerable loss on a big job. On the other hand, incorrect depth or spacing of holes means more drilling than is necessary, and a consequent increase in that item of expense. The following paragraphs are based upon actual work in blasting for the steam shovel, and an attempt is made by comparing shots and methods to analyze the results.

Holes sometimes miss fire even though the battery is in good shape and double caps are used in the holes. This may be due in some cases to leaving wire connections bare and stringing the wire along the ground. Especially if the ground is damp it will carry off a good part of the current where the bare wires touch it.

Holes for Steam Shovel Cut

On a certain piece of work, the layout of the cut was as shown in Fig. 2. The holes were spaced 6 ft. apart across the cut and 10 ft. apart, measuring from the face of the bench. The cut was a new location running close to and alongside of a main line tunnel, and it was necessary to use as light charges as possible. The rock was bluestone, very tough and rather seamy, a bad combination for blasting, especially on account of the proximity of the old tunnel. The depth of holes varied from 12 to 20 ft.

Regarding the spacing holes across the cut, while a wider spacing might have done as well, the width of the cut was such that three holes were not enough, and four worked in nicely. On the other hand, the close spacing of holes across the cut insured the thorough shattering of the rock between the holes within the limit of the force of the blast.

As to the spacing of the holes back from the face of the bench, results seemed to vary directly with the depths of the holes, so far as the apparent efficiency of the blasting was concerned. With 12-ft. holes, almost no dobeing was necessary. Where dobeing was necessary, it seems to have been on account of too light loading. As the depth of the holes increased without changing the spacing, the necessity of using mudcaps seemed likewise to increase. These results were due to some extent to the necessity of light loading. Wider spacing of the deep holes, with consequent heavier charges, would have remedied the trouble, and could have been used under ordinary circumstances.

Efficiency of Recorded Loading

A record was kept of the various shots, and shows that excessive mudcapping consistently followed the firing of deep holes with a light burden. Holes 1, 2, 3 and 4 in Fig. 2 were loaded respectively with 43, 15, 20, and 20 sticks of 40 per cent dynamite. Holes 5, 6, 7 and 8 were loaded with 55 sticks each, after having been sprung several times with up to 20 sticks with about 2 ft. of tamping. When finally loaded the holes were tamped full depth with clay. When these 12-ft. holes were fired the rock was lifted, shattered, and dropped back into place. Very little rock was lifted into the air, possibly because of the light loading of the front holes. It was necessary to fire one mudcap after this shot. This was probably due to the light loading.

Later, in the same arrangement of holes, the first four holes and two extras were drilled 12 ft. deep, and the second four, 20 ft. deep. The entire loading consumed 375 lbs. of dynamite. This shot was followed by seven dobes. At another time four 12-ft. holes loaded with 40 sticks each and two with 60 sticks each, were fired. No mud capping was necessary after this shot. Later a shot was fired consisting of three 20-ft. holes, two 12-ft. holes and five toe holes, consuming 375 lbs. of dynamite. Before the muck from this shot was cleared away 18 dobes had to be fired.

Close spacing of holes across the cut generally assures the shattering of the rock, while the longer spacing back from the face guards against blowing the rock forward too much. Having the proper burden in front of the hole means that the rock will be lifted, shattered, and dropped back into place. There will be very little scattering and flying of the rock. At the same time, the correct depth of the hole in relation to the burden insures that, with the proper charge, the rock will break all the way to the mouth of the hole and to the shoulder, and as a rule no big pieces will be left to dobe.

Analysis of 12-ft. Holes

An attempt is made in Fig. 3 to analyze and explain the action of a blast, and to discover why one depth of hole will prove more efficient than another. A 12-ft. hole is shown, "sprung" or chambered at the bottom, the charge being completely within the sprung or enlarged portion of the hole. The depth of the hole is shown from a to b, and the burden is indicated by the distance W. Dynamite acts equally in all directions. Let us indicate the horizontal force of the blast by the line cd. Since the force is the same in all directions, there is also a force equal to cd, acting against the solid rock in back of the hole. It is probable that about half of this force is reflected from the solid rock in the same direction as cd. This is represented in the diagram by the line bc.

These two forces, bc and cd, represent the total force of the blast, acting horizontally on the rock to be broken. Since the force is the same in all directions, there is, acting upward, a force ef, equal to cd, and a reflected force be, equal to bc. If we construct a parallelogram of forces on these, we get as a resultant the line bg, acting at an angle of 45 deg. There is, however, another force to be reckoned with. That is, the weight of the rock which is being broken. At first glance, this force would be said to work downward, and so far as the actual weight of the rock is concerned, it does. But from a point of view of efficiency, it works upward. This may seem contradictory, but my theory may be explained as follows:

The horizontal forces, after pushing the rock outward, have done their work and the rock is broken by the direct force of the blast. After pushing the rock outward the force is dissipated through the opened fissures. The forces acting upward, however, meet an added resistance in the weight of the rock against which they are acting. Instead of falling out of the way, as does the resistance to the horizontal forces, the resistance to the vertical forces is held in place and even increased by the force of gravity. Therefore, the unspent energy of the upward forces, instead of being dissipated, goes on doing work or breaking the rock opposed to it until it is expended, or until it has forced its way through the mass and freed itself. Thus the weight of the stone, instead of acting downward, acts, from a point of efficiency, as an aid to the force of the blast, inasmuch as it holds the rock against the force until the full strength of the blast has acted on the rock. This being the case, the added force, or more properly efficiency, due to the downward pressure of the rock, is indicated in an upward direction by the line fh.

Parallelogram of Forces

Since the weight of the rock could not exert a force greater than the resistance due to the solid rock back of the hole, assume that fh is equal to bc. Constructing a parallelogram upon bd and bh, we get a resultant bi. It will be noticed that the distance hi, or W, is ¾id, which agrees very well with the usual proportion used in practice for the depth of hole as compared to the burden W. If we accept this explanation of the forces as correct we should say that the 12-ft. holes used in this work were about right, or could have been a foot or so deeper, and the facts bear this out, since, when the proper charge was used, the rock was well broken with this depth of hole, and practically no mudcapping was needed after shooting 12-ft. holes.

Now let us consider the results obtained with the 20-ft. holes. It has been noted that with this depth a good many unshattered pieces were produced, which required mudcapping and consequent loss of time. The burden is indicated by the distance W, in Fig. 4. The depth of the hole is ab. In this case more dynamite is used; therefore the forces bc and cd, acting horizontally, are greater than in the former case, but are assumed to be in the same proportion. The same forces act upward, shown at be and ef. We also have the force fh, due to the weight of the rock pressing downward against the blast. As before, since the force fh cannot be greater than the resistance of the solid rock, assume it equal to bc.

Constructing a parallelogram on bd and bh, we

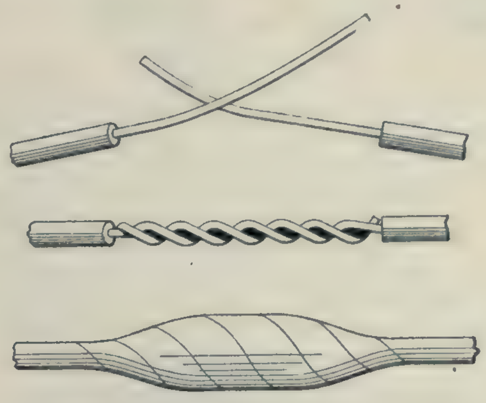

FIG. 1—CORRECT WIRE CONNECTIONS

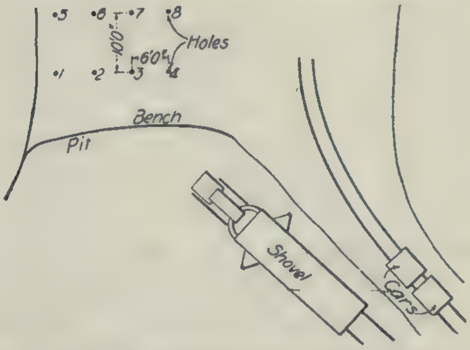

FIG. 2—PLAN OF STEAM-SHOVEL CUT

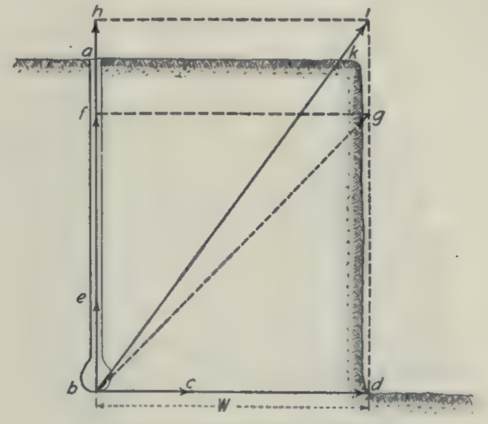

FIG. 3—12-FOOT HOLE

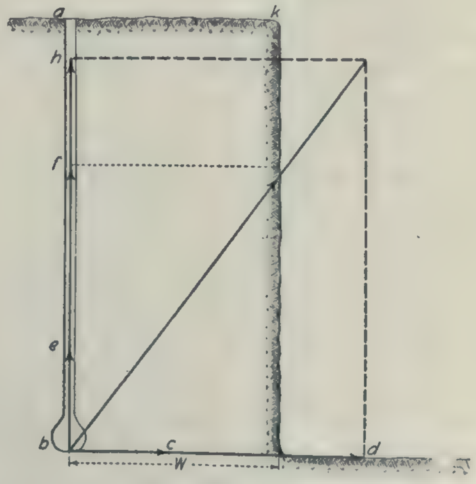

FIG. 4—20-FOOT HOLE

have as before a resultant acting in the direction bi. This dissipates itself at i, where it leaves the rock. Above this point there is the rock ikaf, which loses the effect of the strongest force, bi, the resultant of both horizontal and upward forces, and is broken merely because it cannot resist the expansion and cohesion of the shattered rock beneath it. This overhanging piece is not, to any extent, acted upon directly by the force of the blast. Some of it is broken because it is pulled apart by its cohesion to the shattered rock below it or falls because the support is blasted from under it. Not being directly subjected to the shattering force of the dynamite, it is not shatered but falls in big pieces which must be broken later by mudcapping.

Weight of Rock

Most writers on the subject of blasting speak of the "resistance due to the weight of the rock," treating it as simple resistance, in which case it would require more force in an upward direction than in a horizontal direction. If this were so we should have to drill our blast holes shorter than the burden, or distance W, in order to break the rock at the top of the holes. On the contrary, we almost always drill heavy blast holes deeper than W. Therefore within certain limits the weight brought about by the extra depth must be beneficial.

Authors in seeking for an explanation of the shattering forces at the mouth of the hole have mentioned the force of the escaping gases along the hole. This, it would seem, would not have a very great effect, becaues of the small area of the hole. On the other hand, if the confining influence of the rock is taken into consideration as above, and considered as beneficial within certain limits, it explains to a great extent the reason the rock breaks at the top of the hole as well as, or better than, that on the face of the bench. It must be remembered that the first fissure or crack opened to communicate with the atmosphere at the front lets out a certain proportion of the force acting in that direction, while the forces acting in an upward direction are confined by the weight of the rock until they have produced work to the full extent of their energy. As worked out herewith the best depth for a sprung hole should be about 4/3 W. This seems to agree with the practical examples given. In shorter holes where the weight of the rock would be small the conditions would of course be different, but the work described represents common practice in blasting for steam shovel work.

Most treatments of this subject consider the firing of a single hole and make the main point the computing of the charge. In general practice, the charge is best determined by trial. In general it might be said that the weight of the burden increases at the square of the burden W. There is another question which should be given attention, and which I believe would be of considerable interest to engineers, and that is a practical comparison of results obtained by different spacing of holes across the cut. As before mentioned, most writers on the subject of blasting neglect this point and are mainly theoretical.

While it is interesting to know how to calculate charges, they are not as a rule computed in the field but are mainly estimated from the experience of the man in charge. The proper depth of hole and the reasons therefor are not always clearly understood even by the experienced rock man, and I have tried to cover them in the light of practical results. On the other hand, I have not as yet had the opportunity to compare definitely the results of various spacings of holes across the cut under similar conditions, and would like to see the matter discussed by someone who has made observations in this line.—Engineering Record.

Inclined Conveyor Belts Handling Wet Concrete

In completing the upper part of the Lake Spaulding dam, built in Central California for the Pacific Gas & Electric Company, it was necessary to elevate the concrete above the mixing plant in order that it could be conveyed several hundred feet along the crest of the structure. Details are given by The Engineering Record. Instead of the usual hoist it was decided to install motor-driven, continuous belts for this purpose, and the 6-ply canvas belts with a 1/8-in. rubber coating which were used are reported to have given good satisfaction.

Beginning at the mixing plant, where four 1-yd. Smith mixers were employed, the concrete passed down a wooden chute which discharged onto a 28-in. belt moving at the rate of 420 ft. per minute and inclined upward at an angle of 20 deg. After being carried about 100 ft. on this belt, the concrete was discharged into a wooden flume, down which it flowed to discharge onto a second belt inclined upward at an angle of 18 deg. and operated at the same rate as the first. After this second lift the concrete could be chuted by gravity to the portions of the structure most remote from the mixing plant. Each belt was operated by a 20 h.p., 220-volt motor.

About 240 cu. yd. per hour were moved. The liquid portions of the mix did not separate and run back on the 20-deg. slope, it is reported, and it was found possible to clear the belt of its load at the upper pulley. A revolving wire brush was first installed to clear the belt just as it returned over the upper pulley, but it was later found more effective to replace this with a compressed air blast. The air was directed against the belt at 100 lb. pressure through 1/32-in. holes 1 in. apart in a 1/2-in. pipe.

When a piece of elevator machinery weighing 3,275 lbs. was being hoisted to the roof through the skylight of a two-storey portion of a bank building at El Paso, Tex., the rope carrying it snapped and the load dropped 85 feet. It fell upon a floor slab 5½ inches thick made of 1:2:4 concrete and provided with a main reinforcement of 1/2-in. square twisted bars spaced 6 inches o.c. and a temperature reinforcement of 3/8-in. square twisted bars, spaced 30 inches o.c. The result of this unexpected test was that a hole was made in the floor and that at a foot below the floor level the reinforcement held the piece of machinery. Practically no damage was done to the adjacent beam supporting the floor.

The water power resources of Canada are to be advertised at the Panama Exposition in San Francisco next year by a series of models of typical power plants from the Atlantic to the Pacific. These will be arranged in semi-circular form in the Canadian building, in front of a large painting presenting a bird's eye view of the whole Dominion. All known water powers, whether developed or undeveloped, will be depicted on this painting, which will be 75 ft. by 9 ft. Mr. Gibson Catlett, Toronto, has been entrusted with the execution of the painting.

Modern Methods of Preventing Explosions in Sewers*

WHEN a sewer is to be entered, or a lighted lamp or candle is to be lowered into it, great care should be exercised to avoid danger of explosion. Men accustomed to this work will quickly perceive the presence of illuminating gas or gasoline vapor, by the odor. This is the safest method of testing the air, but the observer should be careful to note whether the air is entering or emerging from the manhole, otherwise he is likely to mistake the absence of odor for the absence of gas in the sewer. If it is necessary to enter the manhole to determine the presence of gas, this should be done without a light, unless it be an electric lamp, and the man entering should wear a life belt with a line leading to his helpers at the top of the manhole. Although seldom done, it is always wise to open several manholes on the sewer to be entered some little time before the entrance is to be made, in order to provide a change of air within the sewer.

An inspection in, or very close to a manhole, should never be attempted by one man alone; the inspector should have at least one helper both for his protection and that of the public, and usually more than one. The helper should remain standing at the top of the manhole to warn approaching persons of the opening. Where the inspector is to go from manhole to manhole through the sewer a second helper should precede him to the manhole below that at which he enters. When the inspector has reached the second manhole, the second helper signals the first one at the first manhole, who replaces the lid and passes on to the third manhole, awaiting the arrival of the inspector at this point. Three men constitute the minimum safe size of gang for such inspection, and preferably two men should go together through the sewer.

Danger of Explosions

Many explosions have occurred in sewers, due to explosive mixtures of illuminating gas, naptha vapor and possibly other gases. Illuminating gas leaking from a defective gas main may find its way through the ground and into a sewer in sufficient quantity to cause an explosive mixture. Most sewer-maintenance superintendents have had experiences of this kind, although relatively few instances have resulted in explosions. It is not always easy to find the source of such gas, as it may travel a considerable distance from the point where it enters the sewer to the place where it is detected.

During recent years, trouble has frequently resulted from the discharge of gasoline into sewers, largely from automobile garages. Gasoline vapor is considerably heavier than air and therefore is not always readily distinguished by its odor when the observation is made from the top of the manhole. This new source of danger has necessitated ordinances preventing the discharge of gasoline into sewers and approving lighting appliances for the use of inspectors and laborers while working within the sewers.

An explosive mixture may result from the decomposition of the organic matter in the deposits. By such decomposition, marsh gas, or methane, may be produced in considerable quantities, and if there is not an adequate circulation of air to provide ventilation, it is conceivable that the proportion of this gas to the oxygen in the air in the sewer may be sufficient to provide an explosive mixture.

Other Sewer Dangers

Even though the danger of explosion is avoided, in exceptional cases gases may be present in sufficient quantities and of the proper kind to endanger the lives of the men working in the sewer. Illuminating gas, while most common, may usually be detected by its odor. If, however, there are some gas-works wastes in the sewage which impart odor to the air and yet are not dangerous, the men may gradually come upon a quantity of illuminating gas without noticing the difference in odor, and be overcome.

There is also danger from marsh gas formed in decomposing deposits and liberated in large quantities when these deposits are disturbed, as by being shovelled or walked upon. Hydrogen sulphide may also be formed under similar conditions, especially where the sewage contains sulphates, as from very hard water or sea water. An illustration of such conditions is furnished at the end of the Los Angeles Calif., outfall.

Another illustration is afforded by the death of three experienced sewer workmen at New Bedford, Mass., on April 10, 1914. A section of an intercepting sewer had been closed by a bulkhead in order that the portion below the bulkhead might be put in use while that above was being completed. The men entered the sewer at a manhole 500 ft. above the bulkhead. They adopted none of the precautions advised in this chapter. About 8 hours later, their bodies were found by a searching party under conditions which indicated that they had probably worked their way well down toward the bulkhead, when they discovered the presence of gas. One of them escaped to within 100 ft. of the manhole and then fell over with his face in a little trickle of water on the invert, in which he was probably drowned. The others did not get nearer than 300 ft. to the manhole; their bodies were found against the wall of the sewer, the arm of one through that of the other in a way indicating that he was helping the latter along when both collapsed.

The only practicable way in which to avoid danger of being overcome by such gases as may be found in sewers under exceptional circumstances appears to be to provide liberal ventilation before entering and while working in them. Care should also be exercised to provide young and vigorous men for such work, to see that there are sufficient men in the party to provide necessary assistance in case of need, and to require that life belts be used, when the men are in particular danger. For emergencies, the breathing apparatus used in mine-rescue work and for entering burning buildings may prove useful.

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* Reprinted from a forthcoming book on "Modern Sewerage Practice," by Leonard Metcalf and Harrison P. Eddy. McGraw-Hill Book Company, publishers.

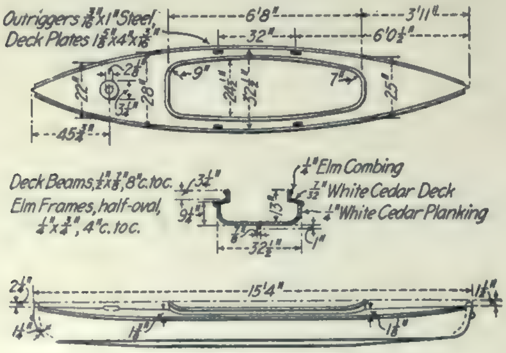
An Engineer's Canoe

ENGINEERS engaged in reconnoitering work may find something of interest in the accompanying drawing, which is submitted by a reader of the Engineering Record. One or two men can sleep in this canoe comfortably by putting their feet in the ends and their heads toward the centre, using the sail for a boat tent, and mosquito netting or cloth at the ends. Thus nothing will get to them; even though they may roll a little in their sleep, snakes and other reptiles will not get nearer than the outside of the boat. This, as some who have been engaged on such work know from experience, is an important point. The writer continues:

"I prefer to have a pair of oars, a good paddle and a small rectangular sail that can be rigged as a spritsail by reefing a corner back, with good, substantial grommets at the corners and about 1 ft. apart on all edges, and about 6 x 8 ft.; when used as a tent the 8-ft. way is put fore and aft of the boat, and very small rope passed through some of the grommet holes and under the boat enables the sail as a tent to be drawn tight against the boat.

"A small box about 9 x 14 x 5 in. deep, outside measurements, is a great convenience and should be made with a hinged cover and lock. It forms a good seat for use in rowing and a convenient little place in which to lock up notebooks and small instruments.

"One man can easily carry this boat, if well made of good light cedar, over a moderate portage, as it only weighs about 75 lbs., or with the two oars, outriggers and rowlocks, a 5-ft. single paddle, stub mast and two spars with sail about 100 lbs., and yet the boat is strong and stiff enough to stand hauling over logs and bars and stony places. If well built of first-class materials, with smooth skin outside and all joints made up with white lead and oil or waterproof marine glue, and all copper rivetted with burrs, such a boat will cost with the fittings described from $75 to $100.



Details of Engineer's canoe

"In having one built care should be taken that the bilge planking is made to a proper cup shape at the turn of the bilge, as otherwise it is likely sooner or later to check on the outside and become leaky. The advantage in having the bilge as sharp as shown is its readiness to stand right side up and not rock or roll easily—an important point in any boat, and particularly in one as small and light as this, in which a man often entrusts his life in strange waters.

"I have travelled many miles in a boat like this with great comfort. I have been caught out on the Mississippi in summer squalls when neither bank could be seen and big steamboats have tied up, and have come through without danger. The boat rows easily and a man can make from twenty to fifty miles a day under oars in still water.

"Some points in the construction of the boat can perhaps be mentioned with advantage. One is the high combing, which somewhat stiffens the boat and deck, but is particularly advantageous in choppy water or when the boat is heavily loaded. Another point is the use of numerous small wide frames or ribs, which do not weigh much, but hold the planking together in a most satisfactory way, and being thin and near together, do not hurt an old man's bones when he lies on them with only a summer blanket under him."

The announcement is made that the course in architecture, leading to the degree of Bachelor of Architecture, at McGill University, has been increased from four to five years. Those who entered previous to the present year will be permitted to finish their course in four years' time, but students who enter in 1914 and thereafter will be required to take the full five years' course. The securing of a thorough education is stated by the University Corporation to be the reason for the change.

It is gratifying to note that despite the financial depression now prevalent throughout the world the mineral production in the Province of Quebec last year exceeded in value that of the previous year by nearly two million dollars. The 1913 figure was rather more than thirteen millions. Details are given in an interesting report prepared by the Superintendent of Mines.

An interesting building project is that of the Western Mausoleum Company, Winnipeg, who have obtained from the city of Calgary a cemetery site for the erection of a mausoleum with a capacity for 600 crypts. The building will be of reinforced concrete construction with stone facings. The crypts will be lined with marble.

A Diesel electric railway motor car has been receiving the attention of the railway authorities of Sweden. This car is driven by eletcric motors. The current is obtained from a generator mounted on the car and driven by a Diesel oil engine. Weighing about 70,000 lbs., the car has accommodation for fifty people, and has travelled over 2,000 miles of Swedish railways.

In selecting the permissible working stress to be allowed on concrete, the working stresses usually allowed for other materials of construction should be used as a guide, so that all structures of the same class, but composed of different materials, may have approximately the same degree of safety.

Foundation work is in progress on the office building which is to be erected at Dorchester Street West, Montreal, for the Liverpool, London & Globe Association. Messrs. Nobbs & Hyde, of Montreal, are the architects, and Messrs. E. G. M. Cape, Limited, Montreal, the general contractors. The building is estimated to cost $175,000.

Efficiency in the Waterproofing of Cement Surfaces

By G. H. Cresser

THIS problem is of great interest to the architect, engineer, building contractor and owner, as it is only recently that cement and concrete have been used extensively in the construction of the modern building. With all the advantages that cement has over other materials as to economy and strength, great care must be exercised in mixing and applying it to the finished surface, to get it uniform in color. It has been proved that hollow blocks absorb moisture 4 to 5 per cent. of their own weight and retain this moisture for some time. Damp walls, as we all know well, are a detriment to health, and this factor is appreciated to such an extent that it has actually retarded the use of concrete in some instances.

An argument against cement surfaces is that we do not get a uniform, pleasing color, but get varied shades of dull gray, very uninviting, that do not compare with the rich colors we find in terra cotta, granite, brick and decorated wood surfaces. There is no comparison, as cement surfaces, undecorated, give us a dreary, sometimes dirty, color that does not reflect the light, but absorbs it, and does not please the eye or appeal to the artistic temperament.

Desirable Qualities in Concrete

This little talk is not intended to condemn cement as a building material, but to advocate its use more than ever by improving upon what is done in that line to-day. If we can add to its strength, economy and fireproofing features a decorative rich color, and at the same operation make it moisture and strictly waterproof, we certainly will have a building material that cannot be duplicated the world over.

But, you will say, we have it now to a certain degree. Some makers of cement add color while making the cement. Some engineers and architects specify waterproof powder or liquid to be added to the cement while mixing. This has not been proved a success, as anything of that nature added to cement decreases its tensile strength to such an extent that it is almost unsafe. It also affects the metal used for reinforcements. You cannot get the added color on waterproofing compounds mixed uniformly, and still have your different shades, and this very often deteriorates the concrete body and leaves a bad surface for any kind of painting in the future.

Proper Way to Treat Cement Surfaces

The question now arises: "What is the proper way to treat cement surfaces so as to get them decorated and waterproof?" Washes, brushed on the finished surface of cement, made from waxes, gums, paraffin, etc., have been tried, but without complete success. It was now up to the paint manufacturer and painter to come to the rescue and make cement more popular and practical than ever as a material for building.

The paint maker and painter received very little encouragement from the engineer and cement maker when they first started on this problem, but finally, after years of experimenting upon all the different forms of concrete construction and under all conditions, and after a strenuous campaign of education and putting on sample jobs at enormous expense the "big ones" in the cement business and "big builders" began to sit up and take notice. They now look upon the paint makers and master painters as their best friends, as they have helped them out of many difficulties.

One Method That Was Unsatisfactory

The first method used with paint was to first give the cement a washing with zinc sulphate and finish over this wash with a white lead and linseed oil paint, but the paint does not hold up, and it is now conceded that linseed oil paint is a failure for cement surfaces, as the alkaline salts in the cement attack and disintegrate it.

The last and most successful method and material used to-day, and conceded by chemists, engineers and concrete men to properly decorate and waterproof cement, is a specially prepared paint, in several shades, to be brushed on by competent painters. The material contains no linseed oil or white lead and firmly adheres to the surface, filling small cracks and voids. Such a material is made by different manufacturers under various proprietary names, and requires two or three coats, which can be put on damp surfaces, but should be put on dry surfaces, and does not cover more than 200 square feet to the gallon, one coat. This material gives the dead flat finish of cement, and adds to the cost of your contract between 35 and 40 cents per square yard of surface painted. The smooth or rough surface of the cement finish has all to do with the cost of labor and material, as the stucco and rough cast surface requires more material and more brushing than the smooth trowelled surface.

Up to this point I have touched upon cement surfaces of the outside of buildings only. But we have inside walls and floors which must be decorated and made damp-proof, and floors must be made so the cement does not dust off.

Inside cement walls are either in the damp or dry class. Damp walls, especially where there is a water pressure, such as along rivers and walls that get soaked with water after heavy rains, are a problem and should, if possible, be coated on the inside and outside with a paint made from asphaltum products and decorated afterward with regular cement coating. Inside cement walls that appear dry are not such a difficult problem and can be treated the same as ordinary walls.

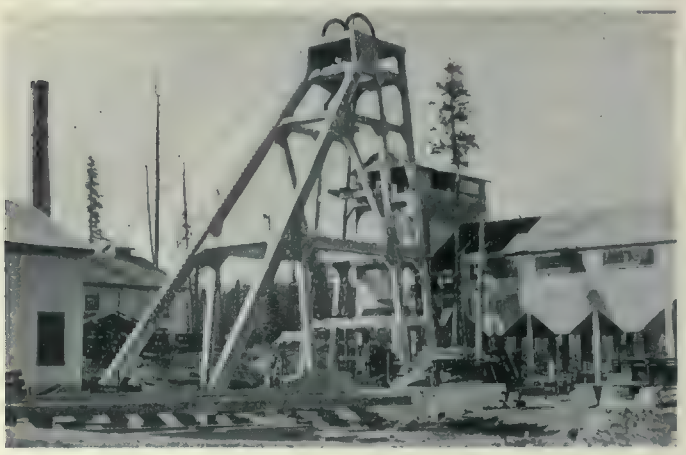
In connection with the damp class of walls I will say that there are on the market to-day several points recommended and made to apply on damp walls, but cannot say as to their success when used against water pressure.

Cement Floors

Another class of surfaces are cement floors. We all know that when put to heavy wear they soon show defects, get slippery or throw off dust, especially where rich in cement and trowelled to a granolithic surface. Giving the floor a cement wash will not answer for factories, shipping rooms or engine rooms, The acids in the lubricating oils attack the cement and destroy its bond. The texture of cement floors and the finish vary so much that we cannot make the same specifications for all of them. They must be tested with specially prepared paint and put on by some one who has made a special study of damp-proofing and decorating cement surfaces.

New Head Frame and Tipple Combine Unique Feature

THE use of reinforced concrete for the construction of coal handling plants is something of a new departure and offers several interesting engineering problems in design. A noteworthy instance of the successful application of concrete to a plant of this description is to be found at Morden, B.C., where the works of the Pacific Coal Mines, Limited, were recently equipped with a reinforced concrete tipple and head frame designed and erected under the supervision of Mr. V. C. Suckow, consulting engineer, Vancouver.



Concrete tipple and head frame, Pacific Coal Mines.

The head frame was built to accommodate two cages with a capacity of 12,000 lbs. each, and is seventy-six feet high from the top of the footings to the centre of the ten-foot sheaves. The frame was constructed with four main posts set vertically in the plane of the frame and with a batter of approximately one and one-half inches in one foot on the cross frame, and two back legs inclined at an angle of sixty-five degrees to the horizontal.

The loadings of the construction, while not in any way excessive, are of such a nature as to require very careful consideration. The jar and vibration caused by the high speed of the cables and the taking up of the slack, are of the utmost importance and for this reason the foundations were carried down sufficiently to give ample anchorage to the superstructure. It was also necessary to provide the most perfect mechanical bond possible between the reinforcement and the concrete, cold twisted steel being used throughout in all the members. All splices were made with laps in the steel of sufficient length to develop the full value of the bars and all beams and struts rods were provided with hooks on the ends to increase the tying or anchorage.

Owing to the vibration and varying intensity of the loads, it was found advisable to have as few members as possible through which the stresses were required to travel before reaching the foundations, and for this reason all the X-bracing commonly used in head frames of wood construction, were eliminated and the horizontal struts and beams were all provided with large gussets or bracket connections at the columns.

The vibration was largely eliminated from the structure by providing a heavy slab at the top of the frame to support the sheave bearings. This slab was made excessively thick with diaphragm connections to the columns. In this way most of the vibration was absorbed before it got into the main members of the structure.

The entire structure was calculated with a factor of safety of ten on both the concrete and steel, and ample allowances were made for wind and other stresses which might occur. One of the inclined legs of the frame was formed to provide a stairway to the sheave platform and had a gas pipe railing at the side, making access to the sheave bearings convenient and safe. The guides for the cages were bolted to cross timbers arranged between the horizontal struts and anchored to them with embedded bolts. The entire superstructure of the head frame required a little over one hundred yards of reinforced concrete.

The tipple offered no exceptional engineering features, the only point being a careful provision against the vibration caused by the Marcus screens, of which there were two. The hoppers or bins were all of the tank type of construction and suspended from the floor beams. An additional two inches of concrete over the required thickness was provided in the bottoms of all bins for a wearing surface. The tipple is designed to handle 1500 tons of coal every eight hours.

All the concrete used in the tipple and head frame was mixed one part of "Bamberton" cement to two parts sand and four parts of three-quarter inch gravel, the sand and gravel being obtained from a bank in the vicinity. All steel used for reinforcement was medium steel.

Cement Joints in Sewer Pipe

WITH reference to the above subject, which was discussed in an article by Mr. J. M. Begg, reproduced in the Contract Record of July 22, an interesting contribution is submitted to our contemporary, The Engineering News, by Mr. W. S. Lea, the Montreal consulting engineer, who writes:

I have had some experience with cement-mortar joints made in three different ways: (1) where a gasket was not used; (2) where a gasket was inserted against the shoulder of the bell in the usual way; (3) where the gasket in the finished joint was at the entrance to the bell all the way round, calked flush with, or a little inside the outside edge of the bell. In all cases, the bottom third of the bell was lined with mortar before inserting the pipe. When no gasket was used, pipe 12 in. and over was centered by two small wooden chips. These chips were also used with the gasket in laying the larger sizes, 18 in. and over. Ordinarily, no difficulty was experienced in centering the 8-in. and 10-in. pipe without chips, whether a gasket was used or not. In every case the joints were pointed from the inside for all pipe 15 in. and over. In methods (1) and (2) the joints were protected with a burlap or cheesecloth band for pipe 18 in. and over.

So far as my experience goes, I am of the opinion (1) that the lower part of the bell should be filled before the spigot of the succeeding pipe is entered, and with more mortar than is needed in that part of the joint; for safety the mortar should appear on the inside; (2) that it is important to use a gasket, not only to assist in centering the pipe, but I believe that the clogging, or slitting up of a gasket calked tightly into the bell, is a considerable factor in preventing leanage in either direction through the joint, where the cement mortar itself is defective; (3) that while no doubt it can be dispensed with, it is safer to use chips to prevent the larger pipes settling at the spigot end; (4) that while it is proper to give the joint a finished appearance by a moderate bevel, the so-called generous bevel is, if anything, worse than useless with the larger sizes, as it tends to sag away from the sides of the pipe; (5) that with the larger sizes, the joint should be supported by a strap of burlap, etc., unless a gasket is inserted at the face of the bell after the joint has been filled up the sides and over the crown.

Moreover, the third method of joint making has appeared to insure the tightest work so far as I have seen it used. This joint is made by lining the bottom third of the bell in the usual way, covering the gasket which is placed along the outside edge of the bell. The gasket is long enough to encircle the pipe, and the two end sections are brought out of the bell after passing clear of the mortar in the bottom. The spigot end of the pipe is then entered with its crown guided against the bell, worked down to center at both ends and bedded. After the joint has been completely filled with mortar, the free-end sections of the gasket are calked into the bell working from the bottom toward the crown. The gasket is driven flush with, or a little within, the face of the bell, the bevel applied, the joint pointed on the inside where accessible, and the surplus mortar cleaned out. There is not very much mortar driven through, particularly with the smaller pipe.

This feature of the mortar forcing through is occasionally objectionable in a way that is hard to avoid. The 12-in. pipe and under cannot be pointed from the inside, and if as sometimes happens, the plane of the spigot end is not perpendicular to the axis of the pipe, there may be a considerable space at the crown of the joint between the spigot end and the shoulder of the bell; and the mortar filling this space sometimes drops to the invert after the pipe laying has proceeded some distance in advance.

When laying 12-in. pipe, this feature has to be watched; it rarely happens with 8-in. pipe, or with the larger sizes where the joints have been pointed from the inside. With the joint made in this way the mortar is firmly held in the bell, and even if the bevel does sag, it cannot carry the mortar out of the bell with it.

I have not found the chips objectionable in the way Mr. Begg suggests; perhaps more mortar was placed in the bottom of the bell; at any rate the chips did not keep the pipe off the mortar; they were practically buried in it, near its upper edges. The chips were placed in this position so that they could be easily moved a little higher, or lower, when occasionally required; moreover, with the chips in this position, any inequalities in either the pipe or the chips do not raise or lower the spigot end so much as if the chips were placed lower down, opposite a diameter approaching the vertical. However, there is no doubt that with the chips omitted, the gasket will generally be fitted tighter in the bottom, and that is a desirable feature.

The consistency of the mortar is an important matter, and not at all easily controlled. The tendency is to have the mortar too soft, as it is easier for the pipe layer to handle. Unless quite stiff initially, the mortar which has been hurriedly mixed, becomes sloppy on further handling, and cannot be easily compacted or retained in the bell. The man who mixes the mortar often has too many other things to look after. The mortar should be mixed in very small batches, and kept thoroughly stirred some time before being used. This permits the mixture to absorb more water, and the proper consistency can be better gauged by the mortar man as further handling does not affect it; moreover, the mortar appears to be tougher, and works smoother.

Mr. Begg has adopted a good specification at Edmonton. Clause (e) which specifies that no joint is to be completed until at least two joints have been bedded and graded in advance is to be particularly recommended. In reading his well presented article, I had hoped to find the detailed description of the work extended to include the method or the procedure followed in bedding the pipe. It is in connection with this, that the most serious difficulties arise in laying sewer pipe. It requires considerable skill and patience to bed a pipe firmly, and at the same time have it lying true to grade and alignment. It is true that once the pipe is in the right position it can be held and supported by tamping proper filling around it with a thin-bladed tool. In this operation lies the greatest risk of lifting the spigot end slightly from the mortar in the bottom of the bell.

It has been the writer's practice to defer tamping immediately around the joint until after the mortar has set up; but in bright, hot weather, at least, the joints were covered with loose earth. Before back-filling the trench the following day, some of this filling was removed, before the tamping was completed. Possibly this was not a good system; care certainly had to be taken to maintain the compacted filling at the same level on both sides of the pipe, so as to avoid jarring it slightly off the line. It is surprising how easily this can be done with even a very light tamping iron.

LETTERS

Regina, August 1, 1914.

Editor Contract Record:

I read your Editorial on Depreciation (Contract Record, July 22) as applied to municipal officials, and I have no doubt that it will be appreciated to the full by the municipal engineering fraternity.

Whilst each official can, of course, make due provision for his own personal physical deterioration, his income is often inadequate to maintain his position and set aside the necessary allowance. Some municipal authorities provide a pension fund for their permanent staff, the funds for which are secured by contributions for the council and the staff.

The concluding remarks of your editorial as to the agitation which is taking place elsewhere for superannuation, should induce the officials to organize a similar movement in this country. At present there is no organization which can or will undertake this duty.

You will remember that last year I advocated the formation of a Canadian Institution of Municipal Engineers, and at the annual convention of the Canadian Public Health Association held in Regina last September, this question was discussed and a provisional committee was appointed to draft the Constitution. I may inform you that the matter has been under consideration, but owing to the time required for correspondence and consideration of the draft, progress has been slow. The Constitution is now nearly ready for publication and I hope to forward you a copy shortly.

If the municipal engineers agree to the formation of such an organization as is provided for in the draft constitution, they can then combine for their mutual professional advantage, for the improvement of their status in society and for a recognition of the need for superannuation—otherwise for personal physical depreciation, as you term it.

In any case, if the above proposition is not carried into effect, something else will be necessary to achieve the object you have in view, for no tangible progress can be made by individual and spasmodic efforts.

Yours truly,
R. O. Wynne-Roberts.

It is reported that negotiations have been opened between Canada and the United States regarding the construction of a canal, 12 ft. in depth, to connect Montreal with New York.

The National Paving Brick Manufacturers' Association meet at Buffalo at their eleventh annual convention, September 9-11. Details may be obtained on application to the Secretary, W. P. Blair, Brotherhood of Locomotive Engineers Building, Cleveland.

Operations are progressing on the erection of the new C. P. R. hotel at St. Andrews, N.B., estimated to cost $200,000. The architects are Messrs. Barott, Blackader & Webster, of Montreal, and the general contractors Messrs. Lyall Sons & Company, Montreal.

Personal Mention

Mr. W. B. Hunt has resigned the post of electrical engineer with the British Columbia Electric Railway Company. He will engage in private practice at Vancouver, B.C.

Mr. A. M. Nanton has been appointed vice-president of the Winnipeg Electric Railway Board in succession to the late Sir William Whyte, a former director of the Canadian Pacific Railway.

Mr. Jeremiah Gallagher, Waterworks Engineer of Quebec, died recently in Montreal. A native of Cork County, Ireland, he came to Canada in 1860. He was a Quebec and Dominion land surveyor and was a member of the Canadian Society of Civil Engineers.

Mr. Thos. Turnbull, who has spent four years with the C. P. R. and the Mason Bay Railway in Western Canada, has been appointed assistant chief engineer of the Canadian Northern Railway, with headquarters at Winnipeg. Some years ago Mr. Turnbull was connected with the C. N. R. in Ontario.

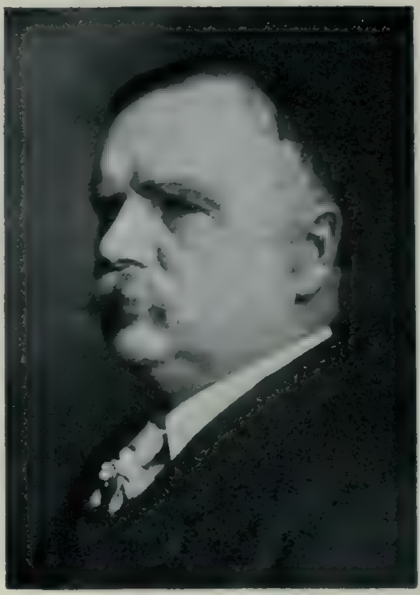
Mr. S. W. Coombe, who until recently was associated with Mr. D. H. Mapes, Superintendent of Construction during the erection of the Hotel Palliser for the Canadian Pacific Railway at Calgary, has been appointed Superintendent of Building Construction under the Dominion Parks Branch of the Department of the Interior. Mr. Coombe's offices are located at Banff, Alta.

Recent elections to membership of the American Water-Works Association include the following Canadians: Mr. R. A. Ross, consulting engineer, Montreal; Mr. R. C. Harris, Commissioner of Works, Toronto; Mr. Jas. T. Wickham, City Engineer's Office, eastern division, Montreal; Mr. Robert B. Owens, B.E., Government Buildings, Edmonton, and Mr. Jas. Barr, M.E., Department of Waterworks, Toronto.

Mr. Kenneth G. Rae has been awarded first prize in the competition for a design for the new city hall and police station, Westmount, P.Q. Eleven designs were sent in, the competition being confined to architects on the Island of Montreal. Mr. Rae receives a premium of $750 and the commission to carry out the work providing the plans are ac- Raine were judged to be of equal merit, and these firms were cepted. Other plans by Messrs. Brown and Vallance, Messrs. E. and W. S. Maxwell, and Messrs. D. H. Macfarlane and H. awarded $200 each.

Something About M. J. Haney, the Toronto Contractor

Michael John Haney is a name well known to the Canadian contracting community, for the man who owns it has been identified with some of the largest constructional enterprises in the country. He was born at Galway, Ireland, in 1854, was educated at Watertown, N.Y., and came to Canada in 1873. He first worked on a farm, but quite early in life he developed a great aptitude for railway construction, and he has carried out, with much skill and success, many important undertakings both in Canada and the United States. One of the earliest positions he held was that of Assistant Engineer on the construction of the Kingston and Pembroke Railway. He was Divisional Engineer on the Lake Ontario Shore Road in 1877, and became Superintendent of the Pembina Branch of the C. P. R. in 1879. Two years later he superintended the construction of Sections 14 and 15 of the C. P. R., known as the Cross Lake Section, which cost four million dollars. In 1882 he was Divisional Superintendent for the lines east of Winnipeg. When only twenty-eight years of age he went with the late Mr. Onderonk to British Columbia as Manager of Construction of three hundred and sixty miles of the C. P. R. With the late Hugh Ryan he undertook the construction of the Red River Valley line, from Winnipeg to West Lynn, now part of the Mackenzie & Mann system. From 1896 he was associated with Hugh and John Ryan in building the Sault Ste. Marie Canal, following which he became Manager of Construction Work for the C. P. R., for whom he superintended the construction of the Crow's Nest Pass line. For some years he was engaged on a number of important contracts for the Dominion Government. In 1909 he was the contractor for the intake tunnel for the Toronto City Waterworks. Mr. Haney was President of the Canada Cement Company in 1907. Of the many corporation offices he holds, it is sufficient in this article to say that he is President of the Point Anne Quarries and also of the Port Credit Brick Company. Aside from his purely commercial activities, his interests are comprehensive. He is on the Board of Governors of St. Michael's Hospital, Toronto, and is a Governor of the Catholic Church Extension Society of Canada. He is Honorary President of the Irish-Canadian Athletic Club, and in 1907 was President of the Toronto Improvement Society.



Mr. M. J. Haney, Toronto

MAINLY CONSTRUCTIONAL

EAST and WEST — FROM COAST to COAST

EASTERN CANADA

At Guelph, Ont., a by-law has been submitted to the ratepayers on the question of the erection of a new collegiate institute in that city at an estimated cost of $125,000.

Tenders are about to be called for the $100,000 warehouse which is to be erected at Montreal by the Harbor Commissioners. The architect is Mr. F. W. Cowie, Montreal.

Prices on mill work and stone are being taken by the general contractors, Anglins, Limited, in connection with the new Loyola College to be erected at Notre Dame de Grace, Que., at an estimated cost of $400,000.

Messrs. Stewart & Witton are busily engaged in the preparation of plans for the hospital which is to be erected at Hamilton at an estimated cost of $200,000. The building will be three storeys high and provide accommodation for five hundred patients.

Nineteen hundred and fourteen is neck and neck with 1913 in the building permits issued at Montreal, where the figures for the first seven months of this year amount to $11,043,432, as compared with $11,497,950 for the corresponding period of last year.

The new building for the Liverpool, London & Globe Assurance Company, which is to be erected on Dorchester street, Montreal, at a cost of $175,000, is already well under way. Messrs. E. G. M. Cape & Company, Limited, Montreal, are the general contractors.

The Christian Brothers community has had plans prepared by Mr. J. P. Hynes, architect, Toronto, for the construction of a training college on their 115-acre property at Oak Ridges, Ont. The building, which is being designed to accommodate 120 students, is 180 ft. long. It is estimated to cost $200,000.

The Toronto board of control has recommended to the city council the passing of a by-law to provide an additional $8,000 for the construction of the Crawford street bridge. The contract was let for $40,669 exclusive of paving, which latter will cost about $2,500. The original estimate was $38,650.

A step towards securing stability in the building trades at Montreal has been taken by the General Contractors' Association regarding the stonemasons' demands. An offer is reported to have been made by the masters offering the men a wage of 50 cents this year and 55 cents next year, with a nine-hour day in summer and an eight-hour day in winter. The proposal has been taken into consideration by the men.

Mr. M. J. Butler, Montreal, Que., has been chosen by the city of Montreal as valuation expert to make an examination of the plant of the Montreal Water & Power Company, a private company which owns the waterworks in the small towns and cities surrounding Montreal. These towns are now a part of Greater Montreal, and Mr. Butler will make this examination with a view to the purchase by the city of all these plants. Mr. Butler is a consulting engineer in general practice in Montreal, and is a director of Armstrong, Whitworth & Company, Limited, of London. He is a member of the American Society of Civil Engineers, the American Society of Mechanical Engineers, the Institution of Civil Engineers, and president of the Canadian Society of Civil Engineers.

The dredge Leconfield, which sank in thirty-seven feet of water last December, while digging in the channel entrance to Courtenay Bay, has been successfully raised by Mr. E. O. Leahey, contractor, of St. John, N.B. The dimensions of the dredge are: length, 135 ft.; beam, 35 ft., and depth 6 ft. The dredge was brought from Rotterdam by the Norton Griffiths Company to assist them in their harbor development contract work at East St. John.

The report for 1913 of the Superintendent of Mines of the Province of Quebec to the Hon. Honore Mercier, Minister of Colonization, Mines and Fisheries, states that despite the general financial depression which prevails throughout the world, the mineral production of the province of Quebec for 1913, which amounted to $13,119,811, exceeds the previous year's by nearly two million dollars. As in the past, the production of asbestos heads the list, the shipments having reached a value of $3,830,504. The province of Quebec supplies 80 per cent. of the world's production of asbestos.

The new office building of the Quebec Harbor Commissioners, which opened last week, is a handsome structure designed after the classic Rennaisance style of architecture. It is built of Deschambault limestone, while the roof and clock tower are covered in copper. The structure is fireproof, consisting of solid masonry walls, steel columns and beams cast in concrete, reinforced terra cotta floors, terra cotta partitions and wall lining. The vestibule and corridors on the three main floors are lined to a height of seven feet with marble. The building was erected from plans prepared under the supervision of Mr. Thos. Reid Peacock.

St. John, N.B., Progress

The Salvation Army Metropole, which was burned last winter, will be replaced by another building, which will be erected on St. James street, a few blocks from the site of the former structure. The Evangeline Home will be used for this purpose with the addition of a brick wing. The citizens of St. John have already contributed $20,000 to the building fund.

While St. John has made rapid progress as a city, both along industrial and other lines, the necessity for cheaper power is becoming more and more apparent. It is expected that this necessity will be met before long by a contract with either one or other of the hydro-electric companies whose projects are before the public. The New Brunswick Hydro-Electric Company, represented by a New York financial firm, have offered the city council special rates (covering both power and light), which have been approved by the city commissioners.

The municipal council of St. John has asked for tenders for the construction of a tuberculosis hospital of brick construction.

The Union of New Brunswick Municipalities will meet at St. John on September 9-10. All the municipalities of the province will send delegates to the meeting.

Within the next few weeks the new refinery plant of the Atlantic Sugar Refineries, Limited, which is regarded as one of the finest in the Dominion, will be in operation. Construction work began in January, 1913, the contractors being E. G. M. Cape & Company, Limited, and the Dominion Bridge Company. The building, nine storeys in height, covers a ground area of seven acres, with a floor space of 175,000 square feet. The motive power is electricity, generated by a steam plant on the premises. The extent of production will be 1,000,000 lbs. per day. The company will manufacture its own barrels. The capital stock is $10,000,000, of which $6,000,000 has been issued.

The process of deepening the oil wells near Moncton, 88 miles from St. John, has been going on lately with satisfactory results. Well 36, deepened to 1,670 feet, is yielding 2,000,000 cubic feet of gas daily. A similar increase is shown in well 35, which has been sunk to a depth or 1,700 feet. If the other wells show like increases upon further boring it will greatly enhance the value of New Brunswick oil prospects.

WESTERN CANADA

The Regina utilities committee is considering the advisability of adding one storey to the offices of the Municipal Street Railway.

It is expected that the building figures at Regina for the month of July will exceed those for the corresponding period of last year by about $100,000.

At Victoria, B.C., work is in progress on additions and alterations to the post office building estimated to cost $150,000. Messrs. McAlpine, Robertson Construction Company are the general contractors.

Contracts for the construction of the storm and domestic sewers at Regina have been awarded to E. G. McVean and the R. J. Lecky Company; the former getting contracts aggregating $26,355.71, and the latter $50,068.40.

Constructional work on the new Grand Trunk Pacific Railway twelve-storey hotel at Regina, Sask., is being rushed as rapidly as possible, over 75 men being employed on this work at the present time. The steel work is well under way.

At Edmonton plans have been prepared by Mr. E. W. Morehouse, architect, for a four-storey office building for Mr. Hugh McFee, estimated to cost $100,000. The building will be four storeys high, of stone, brick and steel construction.

Messrs. Hodgson, King & McPhalen Bros., of Vancouver, B.C., have secured the contract for trunk sewers to be laid in Vancouver to the value of $309,052. Mr. Geo. W. Phipps is the engineer of the work, which is in connection with the Vancouver and Districts Joint Sewerage and Drainage Board scheme.

Excavating is in progress for the new police station which is to be erected at Regina at a cost of nearly $150,000. The building is to be four storeys high, of stone, brick and reinforced concrete construction. Messrs. Clemesha & Portnall are the architects and Messrs. Frid, Lewis & Company the general contractors—both Regina firms.

Contracts representing an expenditure of $51,882 for street lighting and generating equipment at the new Regina power house have been approved by the city council. The largest item on the list is the sum of $32,000, which will go to the Westinghouse Company for a large switchboard consisting of 26 panels of blue Vermont marble, sufficient to control a 15,000 kw. plant. Other contracts awarded are as follows:—The Canadian General Electric Company, $8,570; the Northern Electric Company, $268; the Malone Electric Company, $594; the Siemens Company of Canada, $7,850, and the Burnham Engineering Cómpany, $26,000.

It is expected that the Alaska railway, which the United States Government is building to the extent of 1,000 miles, at a cost of $35,000,000, will be followed by an extension of the line from the Yukon into Northern and Central British Columbia, connecting with the main line of the Grand Trunk Pacific Railway. Preliminary surveys are almost completed and Lt.-Col. Arthur Mears, who has been appointed Superintendent of Construction, is arranging for the commencement of the undertaking.

The Estevan Clay & Pottery Company has been granted its charter of incorporation. The pottery is to be erected about one and one-half miles west of Estevan, Sask., at an approximate cost of $100,000. Samples of pottery produced from clay blends obtained in that locality are said to be of particularly fine quality and capable of excellent finishes. It is anticipated that when the plant is in full swing about three hundred hands will be employed. The provisional directors of the company are A. Bernstein, T. A. Condie, W. J. Perkins, F. T. Taylor and H. A. Cameron.

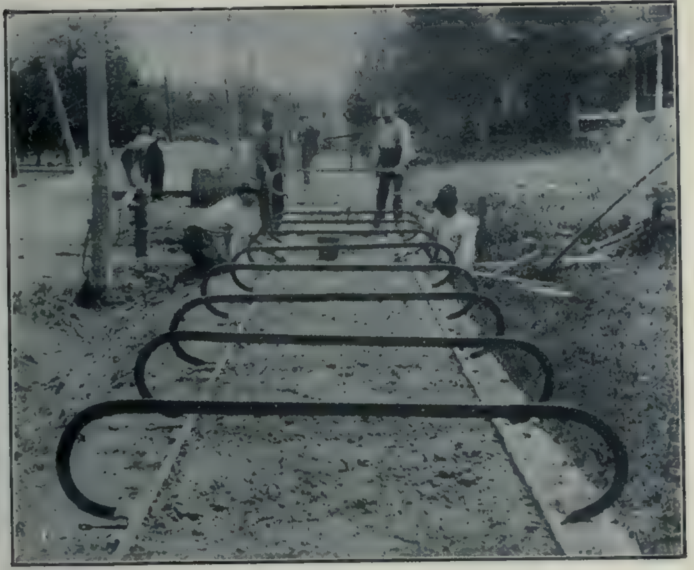
The Dominion Shipbuilding & Drydock Company, Limited, Vancouver, are carrying out a gigantic scheme for the extension of their plant at Lynn Creek. Tenders have been called and will be received until September 1st for a shipbuilding plant, the estimated cost of which is $5,000,000 while bids for the supply of machinery are invited until October 1st. The site comprises 140 acres, on which machine shops will first be built. This will be followed by the construction of two marine railway buildings and two concrete wharfs. The time allowed for the completion of the plant is two and a half years.

A bridge to cost over $400,000 is proposed at Victoria, B.C., to connect the business part of the city with the old Songhees Indian Reserve. About two years ago the Government of British Columbia acquired the reserve, which is situated on the west side of Victoria Harbor, and laid out the land for railroad terminals and industrial sites. The Canadian Northern Railway and the Esquimalt & Nanaimo Railway, which is part of the C. P. R. system, propose to erect a large passenger terminal. Both railways will also have their freight yards on this land. To connect the business part of the city with the reserve it is necessary to construct a bridge across the harbor. The type of bridge has not yet been decided, but it will either be a bascule or swing span. If a bascule, the clear opening between fenders will be 130 ft. If a draw, there will be two openings of 110 ft. each. The Provincial Government, Esquimalt & Nanaimo Railway and British Columbia Electric Railway are contributing towards the cost of the bridge. The bridge is to be designed of sufficient width to carry two tracks for the electric railway, a roadway on each side of these tracks of about 11 ft., and on the north side of the bridge provision is made for a single track for the E. & N. Railway, as it has already freight yards on the east side of the harbor and wishes to still retain the right to bring freight into the city. The total length of the bridge will be about 500 ft., not including approaches. The approximate cost, depending on what type of bridge is adopted, and the width, will be about $400,000, not including approaches or the purchase of the necessary land. The city has undertaken to provide the approaches and to purchase property on the east side of the harbor. The estimated cost of the land is about $225,000, and the approaches, of which there will be two, one from Cormorant street and one from Johnson street, will cost approximately $50,000. The Provincial Government is providing the land on the west side of the bridge. Mr. C. H. Rust is the City Engineer.

Steel Forms for Concrete Sidewalk Construction

THESE forms consist of side pieces made of Standard Carnegie channel sections, 4, 5 or 6 in. in depth as required, reinforced every 4 feet with strengthening ribs. Adjustable clamps known as matrices, for holding the channels in place, and bolts used in the connections are important features of these steel forms. A complete set, with which 100 lineal feet of sidewalk 18 in. to 8 ft. in width can be constructed, includes 200 feet of side channels in lengths of 10 feet with connections, 20 matrices and 30 pins. The matrices are made in three pieces, two curved end pieces and one straight centre piece to each. The shanks of the curved pieces and the straight centre section have holes at 3½-in. centres to permit of spacing the side rails to suit width of sidewalk. One curved piece of each clamp is fitted with an adjusting screw and the other with a flat shoe which gives a suitable bearing on the rail.

When setting up the forms, the side rails are lined up with the flanges outwards. Wooden distance pieces or separators corresponding in length to the required width of the finished sidewalk are placed between the rails. The matrices are then put on at 4-ft. centres and tightened up.



Sidewalk construction with steel forms.

The combination of side rails, matrices and separators make a rigid form in which the concrete is deposited.

When in place the matrices or clamps are well above the top of the concrete. Sidewalks can be made of any thickness up to the top of the side rails.

It is stated by the makers that on one $1,200 contract a saving in lumber and labor costs can be effected which will offset the cost of one set of steel forms, about $200. It is also claimed that lumber costs will be reduced 25 per cent. and a continuous and complete operation in setting, removal and replacement can be effected. The forms are adaptable to any surface conditions and are adjustable to any width to a fraction of an inch.

The equipment above described is manufactured by the Malone Steel Concrete Form Company, George L. Starks & Company, of Saranac Lake, N.Y., owners. Patents have been applied for in all countries.

The Canadian representative is A. E. Patton, 77 Somerville Avenue, Montreal. Several sets have been sold to Canadian municipalities, including Montreal, Longueuil, Verdun, Lachine, etc., and many contractors have purchased the equipment.

The illustration shows the forms in use. The height of clamps above the concrete is clearly shown.

The contract was awarded recently to Messrs. Shuttleworth & Black, contractors, Ottawa, for the construction of an addition to the present dry goods store of Chas. Oglivy, Limited, Montreal. When completed the new store will have a frontage on Nicholas street of 200 ft., and on Rideau and Besserer streets of 66 ft. Mr. W. E. Noffke, Ottawa, is the architect.

Sixteen grillage castings for the new Quebec bridge, now in course of construction, are being completed and shipped by the Longue Pointe Plant of the Canadian Steel Foundries, Limited. The weight of each casting is forty-three tons and the dimensions 21 ft. x 6 ft. 8 in. x 4 ft. The specifications of the Quebec Board of Engineers called for the best quality of material and workmanship, and a rigid works inspection was maintained through all stages of their manufacture. Upon arrival at destination they are bolted in pairs, two pairs to each concrete pier carrying the main columns of the bridge. All of the scrap metal used in making these castings was procured from the wreck of the old Quebec bridge and is of a very high grade of steel.

The Canadian Pacific has just published some interesting particulars about its big bridges. The system boasts hundreds of bridges, but four stand out with distinction and bulk. These are the Lethbridge Viaduct, the Outlook, the Edmonton and the Lachine bridges. The first is 5,327 feet long and 314 feet above the water level; with a weight of steel of 25,000,000 pounds, and cost $1,500,000. It was made up of 44 through plate girders of 67 feet long, 33 girders 100 feet long, and one 167 feet truss span supported on 33 steel towers. It required 645 cars to transport steel used in construction. The second bridge, across the South Saskatchewan River, is 3,004 feet in length, 140 feet above water level, and has a weight of 5,737,000 pounds of steel; cost $900,000. It has 240-foot truss spans, supported by concrete piers, with approaches consisting of three 80-foot, seven 60-foot, and nine 45-foot plate girder spans on steel towers. The third, over the North Saskatchewan, is 2,550 feet in length, is 152 feet above the water level and has 17,204,146 pounds of steel. This bridge cost $1,400,000. The fourth bridge—the Lachine, across the St. Lawrence—is 3,657 feet in length, is 60 feet above water level, has 28,462,931 pounds of steel, and cost $2,000,000—that is for converting into double track, besides the original cost of the structure, which was something like $1,500,000. There are three 80-foot, nine 120-foot, four 240-foot, two 270-foot, and two 408-foot spans. It has 19 piers and 3,500,000 rivets, and 3,500 cars were required to handle the material employed in the entire structure.

A bulletin issued by the Herbert Morris Crane & Hoist Company, Limited, Toronto, describes interesting features of the new Morris Telescopic Ash Hoist. This hoist was designed primarily for use in basements having trap doors to the sidewalk. The head of the hoist is raised into position simply and effectively and is returned to its place below the grade level when not in use. The separate lifting gear can be used for many other purposes around the building. The jib-head swings around to deposit the load right on the sidewalk. The Herbert Morris Company lately received an order for four of these hoists from the Board of Education of the city of Toronto.

Contracts Department

News of Special Interest to Contractors, Engineers, Manufacturers and Dealers in Building Supplies

Waterworks, Sewerage and Roadways

Belleville, Ont.
It is understood that the city council contemplates laying cement walks in connection with the new Queen Mary School.

Dunnville, Ont.
Tenders for the construction of sewers on Park Ave., Ross Ave. and Cedar St., are to be called shortly. Plans are now being prepared by the town council.

Dundas, Ont.
Plans for a new reservoir and storage basin are being drawn by the town council. The engineers in charge are Messrs. McPhee, Kelley & Darling, of Hamilton.

Fort William, Ont.
The city council proposes to construct granolithic sidewalks on Donald St. and N. Syndicate Ave., also curbs on John, Harold, Marks and Norah Sts.

Hamilton, Ont.
It is understood that nothing will be done this year in regard to the proposed construction of an overflow sewer system.

Hamilton, Ont., Burlington
A by-law has been passed by the village council providing for the extension of the waterworks system into the new survey at a cost of $12,000.

Halifax, N.S.
Tenders will be received by the mayor until noon Aug. 19th, for the construction of granite block and sheet asphalt or bitulithic pavements. Specifications are at the office of the engineer, Mr. F. W. W. Doane, City Hall.

Milton, Ont.
The town council proposes to construct cement walks on Fulton, Main, Pine and Martin streets.

Niagara Falls, Ont.
The city council has decided to construct, by day labor, about 18,000 sq. yds. of brick pavements, with concrete curbs, on Main and Queen streets. A plant for the entire work will be required.

It is also proposed to lay 8-in. to 18-in. vitrified tile sewers on Barker, Joe and Third streets. This work will also be done by day labor. Estimated cost $12,000.

Ottawa, Ont.
Tenders will be received by the Sec. to the Board of Control until 4 p.m. Aug. 20th, for the supply and delivery of 1 cu. yd. concrete mixer; 2 tarvia tank delivery wagons; 1 trench tamping machine; 1 drain cleaning apparatus. Specifications, details and full particulars are to be sent with each tender.

Tenders will be received by Mr. L. K. Jones, Department of Railways & Canals, Ottawa, until noon, August 20th, for drainage work at Clement's Gully, Soulanges Canal. Plans, etc., are at the office of the Chief Engineer, at the Department, Ottawa, and at the office of the Superintending Engineer, Quebec Canals, New Birks Bldg., Montreal.

It is proposed by the city council to lay asphalt pavement on Rose Street between St. Patrick and Water streets. The estimated cost is $7,750.

Peterboro, Ont.
The construction of cement pavements on about 28 streets has been recommended by Board of Works. Plans have been drawn.

Regina, Sask.
The city council is calling for tenders for the supply of 2,016 lin. ft. Standard steel rails, 72 fish plates and ⅜-in. round bars in connection with the sewage disposal works. Specifications are with the engineer, Mr. F. McArthur.

Sudbury, Ont.
The sewerage extensions proposed by the town council consists of 4 miles of sewers, including a system for the west end of the town, and various extensions; also connections from the original system to the recently installed trunk system.

St. John, N.B.
The city council is about to call tenders for the construction of permanent sidewalks on the north side of King St.

The city council has authorized the renewal of 7,000 ft. of water mains on fifteen streets. The laying of about 1,000 ft. of 8-in. pipe in Protection street is also recommended.

Sherbrooke, Que.
The by-law which was submitted to the ratepayers calling for the expenditure of $200,000 on sewers, sidewalks, etc., has been defeated.

Sydney, N.S.
The engineer, Mr. N. Hay, invites tenders for the supply of 14-in., 12-in., 8-in., and 6-in. special valves for the waterworks department.

Trenton, N.S.
In addition to the construction of the water service, the Doane Engineering Company, of Halifax, will install a deep well pumping plant. The total cost is estimated at $25,000.

Toronto, Ont.
The mayor will receive contracts until Aug. 18, for addition and alterations to the high level pumping station. Plans are at the office of the city architect, City Hall.

Tenders will be received by the mayor until Aug. 18, for the construction of the following pavements. Asphalt on 9 streets, bitulithic on 3 streets, rocmac on 1 street, asphaltic concrete on 1 street, concrete walks on 6 streets. Plans are at the office of the Commr. of Works.

Victoria, B.C.
The city council has approved the laying of bitulithic surface concrete base on Oak Bay Ave., also pavement on Davie street. The estimated cost is $13,900.

Wingham, Ont.
The town council contemplates laying 8-in. tile sewers on Edward and John streets, putting in drains and purchasing drinking fountains for the town hall.

Watrous, Sask.
A by-law providing for the construction of cement sidewalks on several streets will shortly be submitted to the ratepayers.

CONTRACTS AWARDED

Grey Twp., Ont.
The township council has awarded to Mr. Henry Ward the contract for the construction of the Barron drain at 22½c per yard.

Hamilton, Ont., Burlington
The local firm of Messrs. Large & Peer has secured from the village council a contract for the construction of 1½ miles of concrete sidewalks at 13c per ft.

Lunenburg, Ont.
The village council has awarded to Mr. John Waldroff, of Newington, Ont., the contract for the contsruction of approximately 10,000 square feet of concrete sidewalks.

Montreal, Que. (Outremont)
A contract has been awarded by the town council to A. Forest, the local contractor, for a 2 x 3 brick sewer from St. Catherine Road to Springrave Avenue.

Moose Jaw, Sask.
The city council has awarded to Mr. E. F. Gedney, of Kerrobert, a contract for the construction of sanitary sewers at $15,979.90, and storm sewers at $13,676.

New Liskeard, Ont.
Messrs. Hill, Clarke & Francis have been awarded the contract for the construction of sewers and walks.

Point Grey, B.C.
The municipal council has awarded the following paving contracts: Ledingham & Cooper, 423 Hamilton St., Vancouver, Yew St., $6,952.50; H. Kaiser & Co., 29th Ave., $13,105.50.

Regina, Sask.
The city council has awarded to Ham, Baker & Co., Ltd., of Langley Green, Birmingham, England, the contract for the supply of 4 travelling distributors, at $3,000.

The Canadian Northern Railway Company has awarded to the Bitulithic & Contracting Company the contract for

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Alphabetical Index of Advertisers Page 18

Vol. 28 **August 19, 1914** **No. 33**

Principal Contents

Business Treason in a New Garb 1037
Where Angels Fear to Tread 1038
Good Roads as Crop Producers 1038
Straightening the North Transcona Elevator 1039-42
By Alexander Allaire
The Organization of the Municipal Engineer's Department 1042-5
By Edward Willis
Constructional Features of the Algoma Eastern Ry. 1046-7
Tunnel Work on the Grand Trunk Pacific 1048-9
Mining Operations in Quebec 1049
Garbage Incinerators and Destructors 1050-1
By Sterling H. Bunnell
Calcium Hypochlorite as a Water Disinfectant 1053
By E. J. Tully
Sewage Disinfection in Actual Practice 1054-6
By Wm. J. Orchard
Oxidation of Sewage Without the Aid of Filters ... 1056
A New Brick-Cleaning Machine 1057
Steel Production in the United States 1057
Grouting and Penetrating Methods of Road Surfaces. 1058-9
By Geo. Green, M. Inst. C. E.
Fraser River Development 1060
The Deposit Cheque (Letter to the Editor) 1061
Mr. W. W. Pearse, City Architect of Toronto—Biographical Sketch 1061
The Municipal Convention at Sherbrooke 1062
Constructional News 1062-4

Business Treason in a New Garb

WERE outside contractors to follow closely the contract procedure of British Columbia, it is a safe venture that that enlightened province would soon have the field of its constructional activities to itself. As recounted editorially in a recent issue of this journal, the City Council of Vancouver not long since awarded to a local firm the contract for a supply of valves, notwithstanding the fact that their bid was twenty-two per cent. higher than that of a United States competitor. There now comes to light the interesting fact that the Council also overlooked an Ontario firm's tender which was only one per cent. higher than the bid submitted by the United States firm. It is additionally interesting to learn that the Ontario concern in question has been obliged to tender on Vancouver contracts through a local jobbing house, as the City Council practically insists upon purchasing locally. Assuming that the jobbing house would get from three to five per cent. for handling the business it is easily seen how outsiders are handicapped.

This particular case would seem to constitute a strong plea for the adoption of a suggestion made a few years ago by the London, Eng., correspondent of this journal—namely, to award contracts to the lowest bidder but one. As a general rule we have not favored innovations of this kind, believing that corruption would inevitably be associated with the authority to discard the low bid. But we have always urged that reasonable discrimination should be exercised by responsible officials and that all facts and figures should be above board and readily available to all. In this instance there was a practically negligible difference between the lowest bid and the lowest bid but one, and the latter was submitted by a Canadian company who for years had tendered successfully and satisfactorily to the city of Vancouver.

In passing over United States industries after inviting open competition, the Vancouver Council has been guilty of a breach of faith; in setting aside the claims of an Eastern Canada firm in excellent standing, it has been guilty of nothing short of business treason.

We return to the subject because we feel strongly that the province of British Columbia has put into effect a policy which is inimical to the best interests of the country. We say British Columbia advisedly because the pernicious example of Vancouver is spreading like a plague. Word reaches us that the city of Prince Rupert has just awarded a contract for waterworks supplies to a British Columbia firm in face of a lower price submitted by an Eastern concern.

We feel that it is essentially the function of a paper whose part is to record the constructional history of Canada from coast to coast, to promote, or strive to promote, the country's development on a national scale. Such broad expansion can never be effected if the British Columbia policy is adopted by the various provinces. In these strenuous days contractors have not the time to enter competitions in which the winners are selected beforehand; and it is a waste, not only of time, but of money, for the expense of tendering is a considerable item in the disbursements of any contracting concern. If the municipalities and business men of British Columbia hold to this policy of discrimination the province will soon be eliminated from the lists of outside concerns who find themselves faced with what is practically a protective duty of twenty-two to twenty-five per cent.

Recent contracts awarded in British Columbia have constituted grave injustice to outside manufacturers—and the province will have to pay in the long run. Breaches of faith in every sphere of human activity bring upon the perpetrators the strongest condemnation. The principle remains constant whether in war or love, business or sport. Germany's breach of faith in the invasion of Belgian territory has brought upon her the condemnation of the rest of the world—and the penalty may be her national existence. Search the pages of history and we find that breaches of confidence have resulted in the ultimate extermination of potentates and powers. Legitimate enterprise alone can survive the combinations which may be arrayed against us.

From their own standpoint the British Columbians' policy is a shortsighted one, for it cannot fail to bring about the refusal of outside manufacturers to tender on municipal work in the province; and it must be evident that if the market is left solely in the hands of local manufacturers the ratepayers will have to pay dearly for their local patriotism, or whatever other apologetic term they may find for it. For our part we regard such patriotism as treason in a new garb—and it was only in our last issue that our London correspondent reminded us of how Dr. Johnson once defined this sentiment as "the last resort of a scoundrel," so that we are in good company.

Where Angels Fear to Tread

CITY Councils throughout the country are undecided as to the action they should take in regard to the salaries and positions of men who have volunteered for active service. In a number of cases it has been suggested that they should receive full pay and in other instances half pay has been suggested. It seems to us that promises of assistance of this kind should be given only at the greatest discretion. Up to the present time there has been no lack of volunteers, and the first contingent might well be composed of reservists and others who are under some obligation to the Imperial Government, supplementing them, of course, by others whose private circumstances enable them to leave no responsibilities behind them. As yet it is a far cry to the time when every able-bodied man will be called upon to shoulder his rifle in the offensive or defensive tactics of his country, and City Councils should proceed warily and not rush into obligations which may be difficult to fulfil later. Perhaps, after all, the best patriot is he who remains cool and collected at his post until his services are actually required. No better loyalty is to be found than in this country, and we are ready to a man, but we must not encourage the parade of reckless sacrifice and adventurousness under the cloak of patriotism. It must be remembered that service is required at home as well as abroad and that strong men are required to remain in charge of the country's business affairs just as much as other strong men are needed in the firing line of the allies. Financial undertakings of the kind under discussion should be entered into only after the calmest deliberation and judgment. At the present juncture it is not incumbent upon us to suspend constructional and all other enterprise, and an equal burden of responsibility should be laid upon all—civic employees not excepted.

Good Roads as Crop Producers

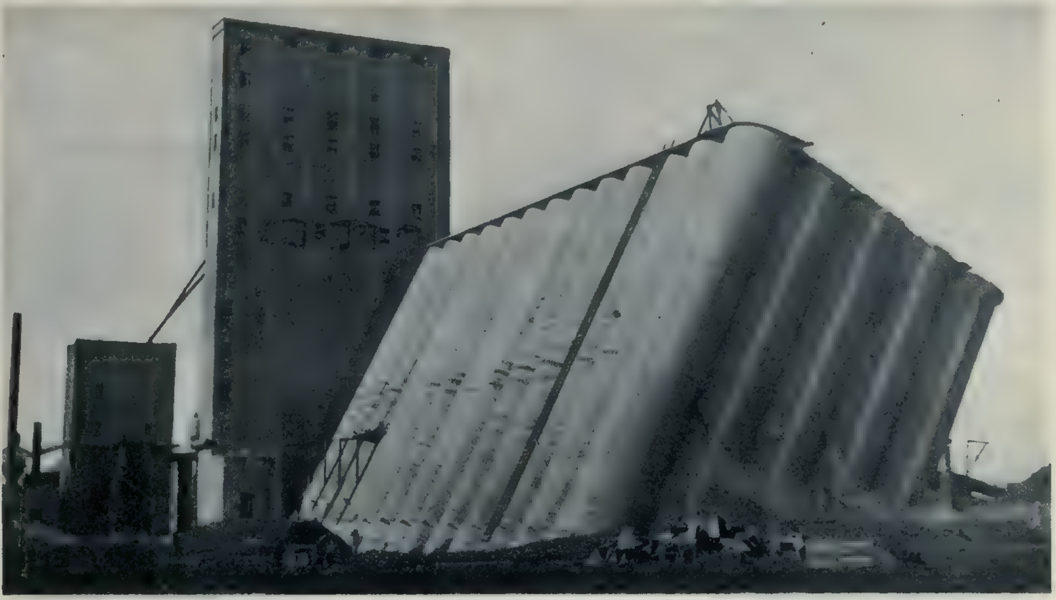
THAT an improved road will increase vastly the productiveness of the area through which it runs, has now been satisfactorily demonstrated by studies conducted by the United States Department of Agriculture in Virginia. Conditions in Spotsylvania county were investigated with particular care and the results have proved surprising. In 1909, the county voted $100,000 to improve forty miles of roads. Two years after the completion of this work the railroad took away in twelve months from Fredericksburg, the county seat, 71,000 tons of agricultural and forest products, hauled over the highways to that town. Before the improvement of the roads this total was only 49,000 tons annually; in other words the quantity of the county's produce had risen more than 45 per cent. Still more interesting, however, is the increase shown in the quantity of the dairy products. In 1909 these amounted to 114,815 pounds, in 1911 to 273,028 pounds, an increase of practically 140 per cent. in two years. In the same time shipments of wheat had increased 59 per cent., tobacco 31 per cent. and lumber and other forest products 48 per cent.

In addition to this increase in quantity the cost of hauling each ton of produce was materially reduced. In other words, the farmers not only produce more but produce more cheaply, for the cost of transportation to market is, of course, an important factor in the cost of production. In the past two years the traffic studies of the Federal experts show that approximately an average of 65,000 tons of outgoing products were hauled over the improved roads in the county an average distance of 8 miles, or a total of 520,000 ton-miles. Before the roads were improved it was estimated that the average cost of hauling was 20 cents a ton-mile. After the improvement this fell to 12 cents a ton-mile, or a saving of 8 cents. A saving of 8 cents per mile on 520,000 ton-miles is $41,000 a year. The county's investment of $100,000 in other words returns a dividend of 40 per cent. annually.

Because this saving, in cases of this character, does not take the form of cash put directly into the farmer's pocket there is a widespread tendency to believe that it is fictitious profit, while as a matter of fact it is just as real a source of profit as the increase in the price of wheat.

In Dinwiddie County, Virginia, for example, where peanuts are one of the staple crops, the average load for two mules on a main road was about 1,000 pounds before the road was improved. After its improvement the average load was found to be 2,000 pounds and the time consumed in hauling the larger load to market was much reduced. In other words, one man with a wagon and two mules could do more than twice as much work with the improved road than with an unimproved road. This is the explanation of the extraordinary rise in the total output of agricultural products in a county with a good road system.—Municipal Engineering.

War or no war, we are told, the Greater Winnipeg water district aqueduct, railway and other works will proceed without check. Mayor Deacon, of Winnipeg, who is chairman of the water district, states that the scheme is on a perfectly sound financial basis and that nothing short of armed invasion by a hostile force will delay the work in the least.



The North Transcona Elevator as it appeared after failure. General view from north-east. Angle of inclination of bins, 26 deg. 53 min.

Straightening the North Transcona Elevator

Methods Employed in the Solution of Unique Problems—Underpinning Work House and Restoring Bins to the Vertical

Specially Contributed by Alexander Allaire*

Of the many remarkable constructional jobs now under way in Canada probably none exceeds in interest the straightening operations in connection with the North Transcona elevator.

The failure of the C. P. R. 1,000,000-bushel grain elevator last Autumn (when, just after receiving its full capacity, the storage bin section settled into the ground and over to one side to a final angle of 26 deg. 53 min.) was caused by the failure of the underlying strata of clay. A decision was soon reached that it would be a practical and economical proposition to try to restore these bins to their former position.

The first thing done was to make an extensive series of borings around the buildings. Eight holes were sunk with the following average result. Starting from the prairie level the different earth strata passed through down to limestone bed rock at elevation—53 ft. were: (1) 35 feet of stiff blue clay; (2) 7 feet of soft white clay and boulders; (3) 7 feet of harder white clay and gravel; (4) 4 feet of shattered limestone, rock and boulders.

The workhouse portion of the structure was not affected by the failure of the bins. It was decided, however, to insure against possible movement of this building by underpinning it with concrete shafts bottomed on bed rock. This work was started in December, 1913, and successfully finished by June of this year. The building is 70 ft. x 96 ft. in area, 180 ft. high and weighs some 13,000 tons. It has been underpinned so efficiently that no settlement or movement of any kind took place, and no cracks appeared.

Forty-four concrete piers, or shafts, were sunk—twenty-four directly under the columns of the building and twenty around the outside, to act as heels for heavy shoring timbers. These outside shafts were sunk first so that the shores resting on them could be erected and brought into action, thus supporting the building laterally, while the interior columns were being underpinned. Six of them were sunk by means of cast iron shoring cylinders—a safe and positive method. The cylinder was made up of sections, each 4 ft. outside diameter and 3 ft. in height. The sections were fastened to one another by bolting through inside flanges at each end of the section. As the sinking progressed, the cylinder was jacked down into place from above, and new sections were inserted and connected at the ground level.

From the knowledge thus gained of the exact soil conditions under the building, it was considered quite safe to use the cheaper Chicago well method for sinking the remainder of the outside shoring shafts and all of the interior ones. The fourteen remaining outside piers presented no special difficulties and were sunk in the usual manner. The piers under the building columns were much more difficult, however, this being due to the necessity of cutting through the concrete mattress and approaching them by means of tunnels, and to the heavy load upon the columns. For twelve interior columns the total dead load was 3,320 tons and the live load 5,008 tons—making a total of 8,328 tons. The outside columns carried 1,728 and 2,512 tons dead and live load respectively.

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*Western Manager, The Foundation Company, Limited.

The method employed in sinking these interior wells was, where possible, to work four columns from a single shaft sunk midway between them. After cutting through the concrete mattress (2 ft. 6 ins. thick) the shaft was carried down to a depth of 7 feet below the matt. From this central shaft, tunnels were driven under the mattress to points underneath each of the four columns commanded by the shaft. Only one sinking well in this set was operated at a time. Single drum belt-driven hoists, operated by d.c. motors, were used to hoist material from the wells. As these motors formed part of the permanent equipment of the elevator, this proved a cheap and efficient method. In some cases it was not possible to group four shafts together, and two were worked from the same opening situated between them.

Three sets of shoring timbers had been installed around the building and these relieved the loads on the interior columns while the work underneath was going on. The outer set consisted of a B. C. fir timber unit made up of five 12-in x 12-in. sticks bolted and strapped together, and stretched from heel-blocks resting on the outside line of shoring piers to head blocks engaging the flared heads (at the second storey level) of the next inside line of columns. The next set of shores, consisting of two 12-in. x 12-in. timbers, stretched from the same heel blocks to head blocks engaging the flared column heads (also at the second storey level) of the second inside line of columns. The third set of shores, made up of four 12-in. x 12-in. timbers, stretched from the spread footings of the first interior line of columns to niches cut (at the first storey level) in the next inside line of columns. Two of the accompanying pictures show the heel and head blocks for an outside shoring unit.

A concrete mixture of 1:2½:4½ was used for the piers underneath both the workhouse and bins.

Operations on the bins were started on March 2nd, 1914, and it is expected that they will be righted approximately to their former position by October. The structure is 77 feet x 200 feet in area and 92 feet high above the base of the bins, or 102 feet above the bottom of the reinforced concrete mattress, which is two feet thick. There are sixty-five bins, in five rows of thirteen each. The total dead load of the structure is 20,000 tons.

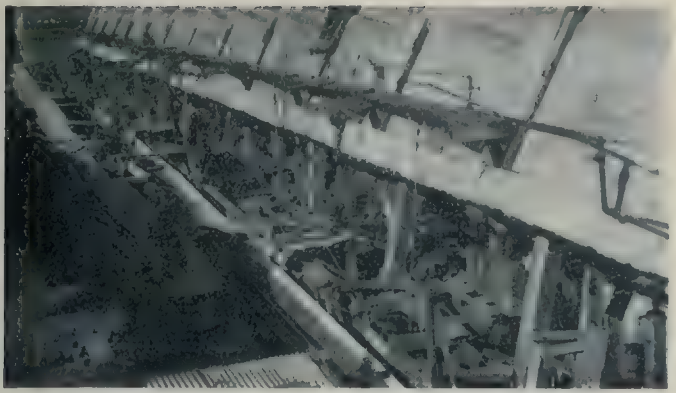
The work was begun by opening up a large trench on the east side. The fundamental scheme in connection with the restorative measures is to allow the bins to settle back, due to their own weight, hinging or heeling on the low side. This trench was to serve as a relief space for the clay bulging ahead of the falling mattress. The trench excavation amounted to some 9,000 yards, and the bottom of the excavation was carried ten feet below the bottom of the mattress on that side. The hand and team method of excavation was decided on, owing to the nature of the material at that time of the year (early spring-melting weather), the clay being too sticky and tough to be economically handled by a steam shovel—the only other feasible method under the circumstances.

Straightening the North Transcona Elevator

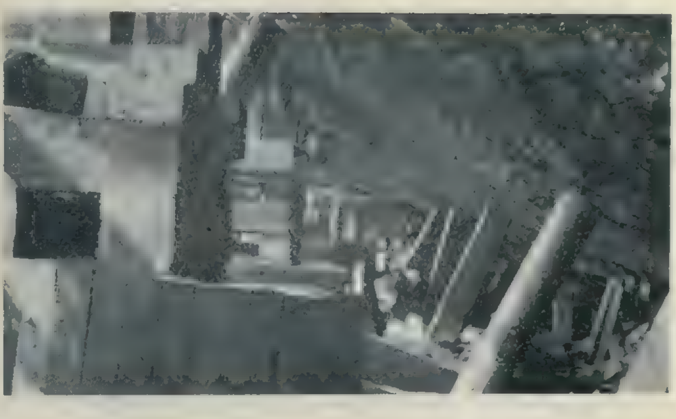
On the left is a view showing head block for outside shoring unit; on the right the reproduction is from a photograph of the east trench, showing method of disposal.

From this east trench, drifts 4 ft. wide and 9 ft. deep at the edge of the mattress, were driven westwards under the mattress diminishing in depth to about 3 ft. at the centre of the building. These were spaced 15 ft. apart, centre to centre. A belt conveyor was installed in the trench close to the entrance to the tunnels and carried away the spoil from them. The material, after being carried to the north end of the building, was dumped on to another belt conveyor, inclined at an angle of 18 deg., discharging up and out into a wooden hopper (capacity 10 cu. yds.) from which the dirt was chuted into wagons and carried away.

To carry the building after righting and to furnish secure foundations for cribbing and jacking units during the process of righting, it was decided to sink seventy concrete shafts under the mattress, each one resting on rock. These shafts were spaced in five rows of fourteen each, and every pier was placed underneath a contact wall between two bins. The outside piers on the north and south ends of the building were made



General view of east side excavation and shoring.



Mattress at east (high) side, showing cribbing, screws and struts.

6 ft. 6 ins. outside diameter, but the inside ones 7 ft. Holes, 4 ft. 6 ins. square at the site of each pier, were cut through the reinforced concrete mattress in order to reach the clay, the cutting being done with Ingersol butterfly jackhammer drills. All of the shafts under the bins are being sunk by the Chicago well method, the hoisting of material being handled, where possible, by single-drum belt-driven electric hoists, and otherwise by hand winches.

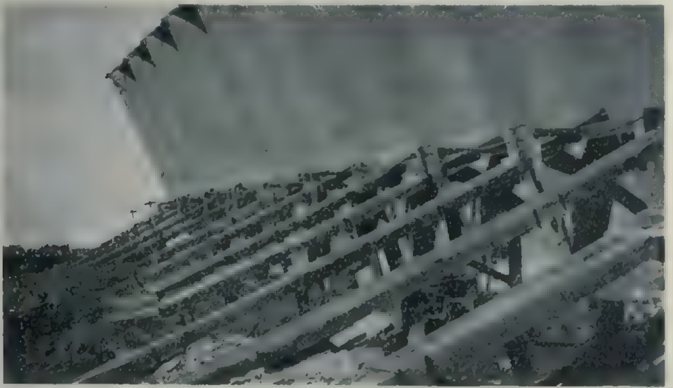
The most difficult, and at the same time the most important, row of piers on the job—that underneath the low side of the bins—was finished first. To reach it through the maze of passage-ways between the mattress and the bin floor, and to convey material to and from it, much less to work in it, was a very difficult proposition, but the piers were all completed well up to schedule time and all landed on first-class bottoms. Immediately after bringing the top of the concrete in the wells to 5 ft. 2 ins. from the mattress, a heavy crib of 12-in. x 12-in. white oak timbers was placed on top of each pier and wedged tightly against the bottom of the mattress. On this line of piers as a fulcrum, the building as a whole, has been slowly hinging back to its original position. To date (August 4) the angle of inclination has been reduced 7 deg. 20 min., and the high side of the mattress has dropped 9 ft. 6 ins.

As the building has settled, it has forced ahead of it, to the east, the clay immediately under the mattress instead of mounting or riding it, as one might possibly imagine. This clay has been disposed of mostly by means of the belt-conveyor in the east trench, previously mentioned, and partly by bleeding out through holes in the mattress on the high side of the bins. As fast as possible, cribs were built on the completed piers underneath the high side and clusters of powerful steel shoring screws were set on them and wedged up to the mattress. These screws, together with numerous posts set on mud sills (all 12-in. x 12-in. timber), have been gradually taking more and more of the load of the eastern or high side of the building as the earth excavation under that side has progressed. Two of the accompanying pictures show conditions at this side of the structure at this stage of the work.

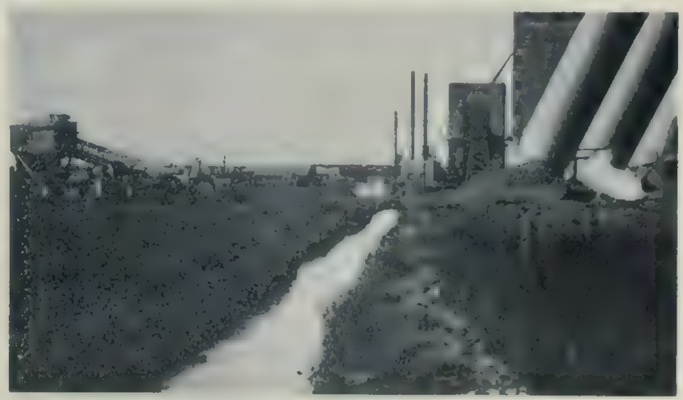
By carefully and systematically slackening the screws, it has been possible, to date, to control the downward movement of the bins absolutely. One of the dangers watched for most carefully was that of letting the screws down too fast for fear the structure might crack. Another was that of the screws bending (and possibly breaking under the enormous weight) due to the angle of contact of the screws with the mattress and the fact that in moving downward the mattress was describing an arc of a circle. To assist in this downward rotating movement of the bins, a row of timber pushers was placed on the west, or low side, footing against a massive continuous mud sill made up of 12-in. x 12-in. timbers. The head blocks and the long head rangers, running the full length of the building, were also made up of 12-in. x 12-in. timbers. The pushers themselves were made up of three 12-in. x 12-in. pieces, 55 feet long, strapped together. Three shoring screws were installed at the heel of each pusher—one in each timber—and were kept continuously under load.

When the screws were run out as far as possible they were "fleeted," or tightened again by inserting cribs between them and the heel ranger. A general view of these pushers accompanies this article.

Considerable water has been encountered in the



General view of west side pushers.



Discharge ditch for pump water. Note dirt hopper at head of inclined belt conveyor on the left.

stratum of shattered limestone just above bed rock. It is estimated that during June, while the most difficult wells were being sunk and concreted, as much as 1,150 gallons a minute, 24 hours a day for several days consecutively, was handled by the pumps on the job. This total is all the more striking when one considers the conditions. Owing to the fact that facilities for moving the pumps about in the passage-ways beneath the bins were so poor, and the available opening through the mattress at the site of a well was so small, none but the very lightest and smallest sinking pumps were used. The well-known pulsometer was the type which gave the most satisfaction under the conditions described. These small, light, sinking pumps discharged from the interior wells into a deep sump pit at the north end of the building. From this the water was pumped and discharged into nearby road drainage ditches by means of powerful steam reciprocating and electric belt-driven centrifugal pumps. For the open shafts under the high side of the mattress where the conditions for placing and handling the pumps were much more favourable, the centrifugal type, belt-driven by electric motors, was found to be by far the most satisfactory. Rigged up as a sinking pump, the motor and centrifugal were both placed on a caged platform, this being hung inside guide timbers by means of block and tackle, and lowered or raised as the water level below demanded. In this way the advantage of a short suction hose was obtained and easily maintained.

The pumping plant at the job consisted of five No. 3 Pulsometers, one No. 4 Pulsometer, one No. 2 Nye pump, one No. 3 Nye, one No. 4 Nye, one No. 1 Emerson sinker, one Prescott mine sinker (6-in. discharge), one No. 8 Cameron sinker, two No. 10 Camerons, one No. 4 Swaby belt-driven centrifugal, one No. 5 Swaby centrifugal belt-driven, and two No. 4 Gould belt-driven centrifugals.

Where all the water came from is not definitely known. It is thought, however, to be part of the same enormous underground river that underlies Winnipeg, and from which the city's present artesian water supply is obtained.

At the time of writing, the average downward movement of the high side of the mattress is 6 ins. per day of 24 hours.

As soon as the middle row of piers is finished, a heavy crib of oak and fir will be placed on each one of them, and, on top of these, oak rockers, wedged up tightly to the mattress. The cribs on the lowest inside line of shafts, about which the building is at present pivoting, are also being enlarged and strengthened; so that when the angle of inclination is approximately 15 degrees, it is expected that the overhanging weight of the east side of the building, combined with a powerful upward force exerted by shoring screws on the two west lines of piers, will cause the structure, as a whole, to rotate or pivot on the rockers on the middle row and rise to its final vertical position.

All the work in connection with the underpinning of the work house and the righting of the bins is being done by The Foundation Company, Limited, of Montreal and Vancouver.

The Organization of a Municipal Engineer's Department*

By Edward Willis, Assoc. M, Inst. C.E., F.S.I.†

To every engineer and surveyor having the management of any large town or city, a thorough knowledge of organization is most important. It is also especially important to the young engineer appointed to a small district since, although he will not have a large staff, it usually becomes necessary systematically to apportion his time and the time even of an assistant, pupil, or office boy, in such a manner that it can be utilized to the best advantage, and no portion of the necessary work appertaining to his department be neglected. . . .

In approaching the subject the author is met with the initial difficulty of the large variation in the work and responsibilities that the municipal engineer has to undertake, and he therefore proposes to deal briefly with only those duties which appertain to practically all appointments, while he will touch but very lightly upon those branches of the department which in large towns and cities are often placed under a separate head, but which in the smaller towns are usually added to the multifarious responsibilities placed upon and undertaken by the modern municipal engineer and surveyor.

Assuming that it is possible to create a new and complete department, the author would suggest the following main headings as the basis of its organization:—(a) Highways; (b) sewerage and sewage disposal works; (c) architectural work and supervision of buildings; (d) open spaces, parks, and pleasure grounds; (e) collection, removal, and disposal of house refuse; (f) sanitary administration, including public conveniences; (g) housing and town planning; (h) fire protection and extinction; (i) stores and depots; (j) miscellaneous; (k) establishment and staff.

The real essence of good organization is the efficient and harmonious working of each section of all departments, with no friction or wasted time where two sections overlap or become interwoven. It is often in this overlapping between the separate sections of a department that most difficulties arise, loss of time is incurred, and individual character, ability, and tact are required to avoid friction.

In the creation of a department for a new small urban district it will probably be found that a very small staff will be allowed for a considerable amount of work, and this must result in several sections of the work being thrown upon one individual. If, however, the scheme is properly thought out and organized, its development will be automatic with the increased prosperity of the district, and no reorganization, with its consequent possible upheavals and heartburnings, should ever become necessary.

It may be desirable before dealing with the above sub-headings to say a few words about the personnel of a staff.

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*Abstracted from a paper delivered at a recent meeting of the Institute of Municipal and County Engineers (Great Britain.)

† Engineer and Surveyor of the Chiswick Urban District Council.

In considering the smallest type of urban district, it may be assumed the staff of the municipal engineer's department consists of one man, described in that most comprehensive word "The Surveyor." If his council are particularly generous he may have the advantage of a pupil and office boy. In this case but little organmation of staff will become necessary, but the organization of work is a sine qua non if the administration of the district is to be efficient, and no harm can result from the scheme of such work being considered on broad, but definite, lines; in fact, the man that can grasp and deal with his work on broad lines is individually the most useful and best organizer, provided he can likewise appreciate the importance of detail.

In the case, however, of an average municipal engineer's office in a town of, say, from 10,000 to 50,000 inhabitants, the circumstances are undoubtedly very different from the foregoing. The borough or district is probably already in a flourishing condition. It may be a quiet town, or it may be rapidly developing, the latter being probably the case in a town or suburb immediately adjoining the Metropolis or some of the great cities of the Empire, or in one which is being developed owing to the creation of a thriving industry within its boundaries.

Arrangements for expansion or possible decentralization may therefore be anticipated and provided for; the individual abilities of each member of the staff should be appreciated to a nicety; the work in each section of the department should be defined and systematic; supervision should be accorded to all; absolute punctuality should be enforced, and integrity of thought as well as of deed should be fostered.

It might be here mentioned that some officials, while being absolutely above reproach in financial matters, still have not grasped that absolute integrity includes principles as well as actions, and the head of a department who can feel that not only integrity, but absolute loyalty to himself permeates every member of his department is indeed fortunate, and such a knowledge is very helpful when the anxieties and worries of dealing with the numerous members of a large corporation weigh unduly heavily upon him.

It cannot be too much emphasized that a true esprit de corps should exist in every official, from the highest to the lowest, to ensure that perfect harmony in work which gives the most beneficial results to the council and ratepayers at large, and therefore any scheme which an engineer can advance to further this spirit will not only redound to his credit, but will probably add to his popularity, and make every individual member of the staff willingly throw his whole energies into his daily work, and not cavil or murmur when the exigencies of the public service necessitate hours of overtime, often without any thanks from his council.

Highways

As the construction and management of highways created the necessity for the surveyor and engineer, so it still ranks as one of the most important duties attaching to his department, and in the majority of districts it is organized as a separate section or subdepartment.

The number of men engaged in maintenance and supervision must of necessity be governed by the area and the traffic throughout the district, but in practice the author advises that existing highways should be dealt with separately from the construction of new highways, since the latter largely consist of private street works and street improvements, and as such are subject to more detailed drawing and office work than the maintenance of existing roads.

The author is of opinion that even in a small district it is wise to make one man responsible for the administration of this sub-department, so that the entire maintenance of the existing roads and footpaths of a district are in his hands. He would then have charge of watering, scavenging, and repairs, including all team labour, manual labour and stores used upon public highways.

The question of improvements to existing highways and lighting in a small district is also left in this official's hands; but where the administration of a large town or city is to be dealt with, he is of opinion that the supervision of both improvements and lighting can be relegated to two other officials, who can personally report to him and specialize in their particular work.

Some engineers require personal reporting daily from the head of each sub-department, and this system has many advantages. At the same time the author has found in practice that there are equally great disadvantages, since in his own experience he has wasted hours in obtaining access to his chief to report sometimes comparatively trivial matters, and the procedure he has adopted in his own office is to obtain all reports in writing from the foregoing officials, who attend for interviews only when required.

Before concluding these observations on existing highways the author would like to emphasise the desirability of not only recording the materials and labour expended on repairs through the outgoing stores notes, but also the advisability of keeping abstracts, charts, and maps of the district showing exactly, from time to time, with the date attached, the amount of recoating carriageways or repaving footpaths carried out each year, and, as far as possible, the prime cost should be kept of all such work and reduced to a definite standard.

While advocating this the author must admit he has been unable, with a limited staff, to keep entirely to this standard of perfection; but he still advises the continuance of such a system as being ultimately conducive to both economy and efficiency.

With reference to watering, he has made a practice of attaching to each water van a small skeleton map of the beat, with positions of all road-watering posts shown thereon, as this tends to prevent the continual waste of time which will constantly occur where the number of road-watering posts is limited, and enables a better check to be maintained over the employees.

The question of scavenging with gangs or one-man beats is a vexed question, and in most districts too little money is put on this important work. The quality of the labour also is often far from satisfactory, any man being considered fit to handle a broom. This is not the author's experience, as he has found that one man can often do twice the amount of work as another, and that such work is often more efficiently performed.

The author considers new highways, especially private street works, can often in a large district be left in the hands of one capable assistant, with one or two draughtsmen to assist him, since uniformity in practice with private street work and apportionments is conducive to lessening of friction with speculating builders and small property owners.

It is desirable that provisional and final apportionment books be kept in lieu of loose sheets, and that such books should give full particulars of the ownership, frontage, estimate, final account and final apportionment, so that the past history of a private street can easily be traced without the necessity of unduly "wading through" numerous loose papers.

In some districts it is customary to have an absolutely standard specification and drawing for private street works; but this has not been the author's practice, since what may be desirable for one highway may be totally unsuitable for another, and in recent years under this heading the author has used from 9 in. to 21 in. of total formation and the following finished surfaces: 9 in. to 6 in. of flints; flints tar-painted and finished with granite clippings; tarred granite; tarred clinker finished with tarred limestone; Guernsey granite with Tarvia and granite chippings.

One other point before leaving this subject may be usefully mentioned. Where trees in streets are generally adopted, they may often be included in the private street works specification and estimated with advantage as well as grass margins, if the cost of maintenance can be reasonably afforded.

Careful records of renaming and renumbering must also be kept, as certificates are continually being required when property changes hands.

Sewerage and Sewage Disposal Works

In this sub-department the author suggests the separation of new and existing sewers from sewage disposal works; in fact, in all large towns and cities such a separation is a sine qua non, in many cases the sewage disposal being undertaken by a joint board, and dealt with either by a sea outfall or bacterial treatment.

The variations in the management of sewage disposal works are, of course, entirely governed by the size and character of the works and the quantity of sewage treated; but it cannot be emphasized too strongly that where the outfall discharges into a non-tidal stream absolute adherence to instructions is essential, especially in the case of contact beds, where three shifts in twenty-four hours is adopted. In this case there is no excuse for lack of attention at night-time, but when men are working twelve or thirteen hours through the night, under little or no supervision, the author has found neglect sometimes ensues.

The author has made a practice of supervising or inspecting personally at all hours of the day and night, without notice, and he has found this has eliminated to a large extent the risk of serious neglect by his men.

Under the heading of "Sewerage" he suggests separating the management of new and existing sewers so far as the individual staff is concerned. This, of course, would again have reference to a large district, or one rapidly developing, and in practice he has found that the outdoor building department can well supervise the laying of new sewers without undue overlapping, since the majority of these are laid in new streets by private estate owners.

Maintenance, flushing and connections to sewers should be as far as possible under the control of one man, who should be solely responsible for seeing to the actual work of the sub-department, but in practice it is often found desirable to arrange for house connections to be supervised by the building department, which, as an inspector should be upon the works daily, saves time and eliminates overlapping of inspection.

It is needless to detail the many sub-headings that would apply in this section, but the author would emphasize the importance of any spare time being spent on keeping the surveys and levels absolutely up-to-date, and shown on the standard ordnance maps of the district. The surface and invert levels should be entered on such maps at every manhole or change of direction or gradient.

Open Spaces

In dealing with this important section of a municipal engineer's work, it may again be reasonably subdivided under the fallowing headings:—

Maintenance of existing open spaces.
Provision of new open spaces.

Briefly referring to the latter heading, the first consideration is defining the most suitable position and negotiating for it. This, of course, is exclusively a matter for the head of the department, probably in conjunction with the clerk of the council.

The design and lay-out construction of walks, banks, flower beds, shrubberies, gymnasia, drainage, water supply, chalets, conveniences, etc., would be best prepared by the indoor staff and the supervision undertaken by the outdoor staff.

A matter which is now continually before municipal engineers is the desirability or otherwise of executing certain new works by means of direct labour. The author has had experience of both the contact and administration systems to some large extent, and he is of opinion that there are many works in which direct labour can be economically adopted; but if they are to be successful and economy is to result, the engineer should have an absolutely free hand in regard to the employment of labour, and should be exonerated from the risk of criticism before the work starts, should he find it necessary to modify the labour conditions.

The question of direct labour is one which, at some time or other, is bound to be considered by every municipal engineer, and no one should neglect to take advantage of the experience of his confreres in this matter. Personally, the author has consistently adopted direct labour on new sewerage works and open spaces with both satisfactory and economical results, while he has found it also beneficial in the construction of open-air baths and various road improvements; but where buildings are to be erected, or where there is any question of payment by other persons, such as in private street works, he prefers the contract system.

The systematic upkeep of iron and wood work is often neglected through carelessness, bad organization, or false economy, and therefore one cannot be too careful in clearly defining the word "maintenance."

Collection, Removal, and Disposal of House Refuse

While this is one of the most important duties usually devolving upon the municipal engineer, it is equally one of the most unpleasant, and is probably the cause of more complaints than any other sub-department.

He must consider first the method of collection and disposal. Collection may be by contract or direct labour, and in each case by either horse haulage or motor traction.

Briefly, motor traction is beneficial where the shoot, deposit, or destructor is at a distance, or it can be economically adopted where the dustbins are placed on the footpath at night and are emptied daily. Direct labour can usually be more efficiently supervised and leads to fewer complaints than contract labour.

Having decided on the system, definite beats should be allocated to certain vans and collectors, and the collection from each beat should be completed each day. If this work is carried out properly no complaints should arise, but the author has found some difficulty in entirely avoiding these, owing partly to the substitution of other men during sickness or accident and the interference with normal organization during holiday seasons.

Some difficulties are also experienced in regard to empty houses or access to occupied houses when no one is at home, but the author's practice on such occasions is to deliver a card stating when the next collection will be made, and the men report on tabulated sheets the reason for non-collection. By this means it is possible to check whether non-collection is through the carelessness of the men or the temporary absence of the occupier.

In the disposal of house refuse, a proper record should be kept of the quantity received, preferably by means of a weighbridge at the destructor. This record should be checked with corresponding periods in previous years, and also with the average daily quantity, which should show a gradual increase with the growth of the district.

Special care is also required in testing the tare weight of collecting vehicles, since although it is wise to record the tare on every vehicle, dust vans are especially liable to be incorrect, owing to the inclusion of "tots," glasses, tins, shovels, baskets, etc., and unless special care is exercised in the clearing out of the vehicle, a considerable excess weight over the actual amount collected may be shown. This, in the case of piecework, may not always be accidental, and to avoid it the only proper method is to tare these vehicles out after every load.

In connection with the destructor, proper records should be kept, preferably in tabular form, of the amount of steam raised, water and coal (if any) consumed, power used for pumping or other purposes, quantity of clinker made, amount of clinker broken in crusher and used for special purposes, such as mortar, brick and flag making, tarred clinker for roads, etc., and a careful analysis of the cost of other materials and labour throughout, so that comparison may be made with corresponding figures at different periods and those of other local authorities, which, with proper allowances for varying conditions, form a good guide as to the economy and efficiency with which this section of the department is being administered.

In the case of extensive repairs to chimney shafts, main flues, etc., provision will have to be made for the removal of the refuse, by road, rail or water, to another destructor or shoot, and sufficient foresight must be exercised to avoid any interference with the normal daily collection and disposal of refuse.

Stores and Depots

A complete or even partial scheme of reorganization in connection with central or branch depots and storeyards requires most careful consideration, since after the cost of buildings, stabling, and other structural works for the reception of horses, vans, motors, rollers, etc., has once been incurred, the capital charge in the event of subsequent alteration will be entirely or very largely wasted. The greatest care and ability must therefore be exercised by the engineer before making any recommendation, and he must not only consider the present, but also the ultimate possibilities and needs of the area of which he is the controlling officer.

It is difficult to lay down any hard or fast line as to centralization, but it may be taken as an accepted fact that all horsed vehicles should be housed within a reasonable distance of the area upon which they are to be used. At the same time the multiplicity of storeyards or depots permanently increases the establishment charges, for which, as a general rule, a varying percentage is required to be added to the cost of works.

Establishment and Staff

The author cannot conclude without making a few observations under this heading. In the earlier part of the paper it was pointed out that perfect loyalty and absolute integrity of thought and deed would tend to result in the development of an excellent staff.

In addition, every assistant should continue his studies by means of professional literature, lectures, etc., and always strive to learn and know more than is necessary for the work required of him, since by that means alone he is able to fit himself for a more responsible position.

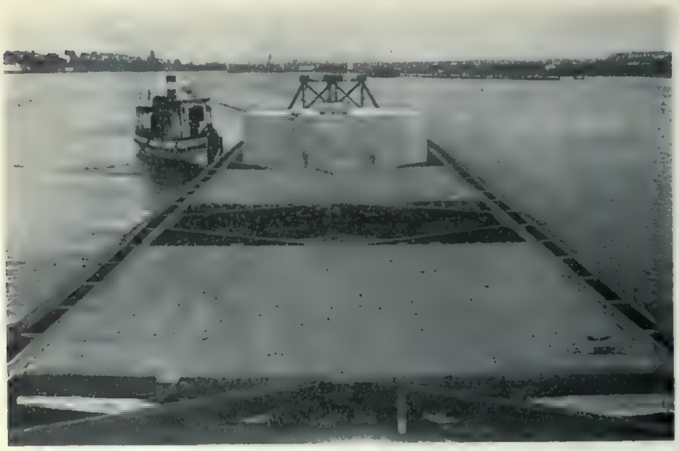
Omitting many other points, one small one must be emphasized—viz., the initialling and dating of all plans, drawings, or documents by the assistants or clerks engaged thereon, and the checking and initialling of all calculations, quantities, and certificates, since it is so easy in the midst of the multifarious duties which devolve upon this department for a slip to be made, but so difficult to restore that confidence which all desire and endeavour to merit.

A reservoir with about 120,000 acre-ft. capacity will be built (shall we say, D.V.?), on the Glatzer Niesse, near Ottmachau, Silesia, Germany. It will be the largest reservoir in Germany, and its construction is expected to take five years. Of the total capacity, 20,000 acre-ft. will be reserved for flood control; for improving navigation on the river Oder, 70,000 acre-ft. will be provided, and it is estimated that in very dry years the river flow can be increased 2,000 sec. ft. The water power can be utilized by fixing the lowest water level in the reservoir. The dam will be about three miles long, and it will be the longest in the world. It will consist of an earth embankment with a masonry core. It has been found that one of the strata of the geological formation of the valley is a layer of clay, 25 ft. thick, extending up on both sides of the buffs, so that the whole reservoir is enveloped by an impervious blanket. The greatest depth of the reservoir will be 40 ft., and its area will be 5,000 acres.

Grass as a soil binder along the banks of large earthfills is discussed in the "Iowa Service Bulletin." Among grasses developing a good system of roots, as well as possessing ability to withstand the hot rays of the sun, the following are termed the best: Hungarian brome grass, hairy brome grass, Canadian blue grass, Fescue grass and Western wheat grass. Quack grass is regarded as a weed. Western wheat grass has unusual ability to grow on the sunny side of an embankment and may, moreover, be easily killed by cultivation. Planting and seeding are said to be equally successful, and, where it is desired to plant, sweet clover and creeping honeysuckle are recommended. These are especially useful in cuts.

Constructional Features of the Algoma Eastern Railway

THE new Algoma Eastern Railway, which has been built from Sudbury to Manitoulin Island, crosses Lacloche Island and Goat Island and reaches Manitoulin at Little Current, where it has its terminal at present. The railway crosses from Lacloche to Goat Island by a fill and a timber trestle, and from Goat Island to Manitoulin by means of a swing bridge across the main channel, and has its terminal station situated at the eastern end of the town. The station arrangements consist of a depot, 47 ft. x 22 ft., and a freight shed 50 ft. x 26 ft., both frame buildings roofed with shingles. The depot is built in an ornamental style and contains baggage and express rooms, office, waiting room and women's room, and abuts on a platform 250 ft. long. The freight shed has an office at one end 11 ft. x 26 ft., and has a dock outside extending along the front of the building, and 50 ft. beyond for unloading cars, while the roadway comes up to the rear of the building. Though the passenger station is on the town side of the channel, the yard and all the terminal arrangements are situated on the small Goat Island, which has been bought up by the company.



Little Current Bridge - View of pivot pier and fender crib.

The first piece of work undertaken was the foundation for the bridge, which was started early in 1913 and continued through the winter, the work being finished at the end of May last year.

The bridge has a central swing span, giving when open two clear channels of 150 ft., and has two shore spans at the north end 70 ft. each and one at the south end 65 feet long. All four piers and the two abutments are founded on the rock, which is at the surface practically, no excavation being necessary except for the abutments. The maximum depth of water at the pivot pier, which is the deepest, is 26 ft. The piers were constructed in open cofferdams built of square timber and caulked. These were framed on shore, towed to position, set, weighted with stone, and then filled with concrete under water by means of derricks and deep sea buckets. The under water concrete was brought up to a level 4 ft. below the water line, when the cofferdams were pumped out and the remainder of the work done in the dry. Small puddle dams were used for the abutments (which are in shallow water), consisting of two rows of sheeting driven, then filled in with puddle, and inside these the abutments were built entirely in the dry.

Owing to the rapidity of the current at the point where the bridge crosses, the channel is hardly ever closed in the winter, and consequently it was possible to set the cribs and to keep a tug at work through the winter. The operations were carried out in daytime only, but during the night the concrete work was covered up and kept hot by steam pipe while setting. The gravel and sand used for the concrete was also kept hot by pipes running through it and the water was heated by steam blown into it. The concrete work has in no way suffered from being built in the winter and its appearance and finish is very good. The pivot pier carrying the draw span is surrounded by a long timber rest pier, over which the bridge swings when open. This consists of six timber cribs 40 ft. long and 35 ft. wide, which were built on shore, towed to position, sunk, and then filled with stone. The cribs are built of round timber to 3 ft. below water level, and the upper structure is of square timber built continuously over all the cribs and bridging over the spaces between them. The end cribs are pointed and two wallings run the whole way round the pier provided with steel plates at the points and angles.

The steel superstructure of the bridge was ready for operation in December of last year. A timber trestle approach was built to the north abutment of the bridge, as it was not thought advisable to fill in behind the abutment until the concrete had had time to become thoroughly hard. This was built in round timber and was used for the erecting of the steel shore spans. The whole trestle has, however, been filled in by the ballast train, and the grade, which was 3 per cent. on the trestle, has been reduced to .8 per cent.

Arrangements have been made on Goat Island for dealing with large quantities of coal, and a coal dock 430 ft. long has been built. This dock is built up of round timber cribs 100 ft. long and 12 ft. wide, with short cribs at the ends running shorewards. The cribs were placed in position and filled in the same way as those in the rest pier of the bridge, and are built separately to 3 ft. below water level. Above that level continuous square timber construction is used and the finished dock level is 5 ft. above the water line. The timber used is B. C. fir, and two oak wallings run the whole length of the dock. Anchor logs 20 ft. long, bolted to the round timber cribs, extend behind the dock under the back fill to give added stability, as the water is shallow here, and after dredging the cribs stood on the edge of a small cliff. A track carried on 24-in. sq. stringers runs along the dock and there is another track 32 ft. distant, long timbers running from one track to the other. A third track is carried on a row of concrete pedestals on the island 5 ft. square and battered 1 in 6; this track also runs on 24-in. stringers bolted to the pedestals. The three tracks carry the traveller for unloading and storing coal. There is a height of 44 ft. below the level of the dump buckets, and the total space which the traveller can cover is

400 ft. by 284 ft., which gives a maximum capacity of about 80,000 tons.

A commercial dock has also been built in the same line as the coal dock and distant from it 605 ft. This dock is of the same construction as the coal dock, but it is planked at the top, and the anchor logs have been dispensed with, as the water is much deeper and the dredging consequently less. The back fill is brought right up to the floor level of the dock and on this a warehouse has been built 80 ft. x 36 ft. for dealing with freight. This is a frame building covered with corrugated sheeting and roofed with Brantford roofing. Practically the entire floor space is devoted to freight but a small office 16 ft. x 18 ft. is provided at the west end. The building is on cedar posts and has its floor level 3 ft. 10 in. above dock level, while a track runs behind the building, enabling freight to be readily transferred from train to boat or vice versa.

The channel along the front of both docks was dredged to a depth of 22 ft., the former depth varying from 6 ft. to 20 ft. The rock was drilled and blasted and then removed by means of a dipper dredge. In the first place the rock was not taken out close up to the dock, but the last cut was taken out afterwards, so that the rock could be blown to an open face to avoid any chance of undermining the cribs.

An engine house has been built at the west end of the island with accommodation for four locomotives. This building is of frame construction, 112 ft. by 96 ft. on a concrete foundation, the three rows of 10 ft. x 10 in. posts carrying the roof being also carried on concrete piers. Four engine pits are provided, built in concrete with a fall toward sumps at their inner ends, and one of these pits is also provided with a drop pit for the removal of wheels and axles with a gantry carrying a three-ton hoist over it. As the engine house is also used as a repair shop efficient arrangements for heating have been made, hot air being the medium. In one wall of each of the pits is a corrugated galvanized pipe 15 in. in diameter, which has openings into the pit at intervals with registers, so that a supply of air may be turned into the pit at any point. In addition there are eight 8-in. standpipes and two 15-in. standpipes with registers placed in the building for general heating. The hot air is supplied by a heater and blower. The interior of the building below floor level is filled with gravel with a 5-in. concrete floor over it and this again is covered with brick paving. The track doors give openings 12 ft. x 16 ft., and have ribbed glass lights in their upper halves to give additional light to the interior. The building also contains a coal bunker and repair benches, the bunker having coal doors above it at such a height that coal can be thrown in from cars standing on a track outside. Arrangements have been made for heating cars standing on the track outside, for which purpose a 1½ in. steam pipe enclosed in a 6-in. tile pipe runs to a concrete box between the rails of the track, where it can be connected to the heating pipe of the cars.

The engine house is roofed with Brantford roofing and carries four Dickinson cast iron smoke jacks supported on timbers in the roof and situated over the inner ends of each pit 15 ft. above rail level. There are also two 30-in. Burt ventilators at the outer ends of the pits.

A Fairbanks-Morse coaling plant has been installed for coaling locomotives, etc., of 100 tons capacity. The cars discharge into a concrete hopper over which the rails run on girders, so that the cars can dump on either side of the track, and the coal then passes through a door at one side into a booth, from where it is lifted by a bucket elevator into the coal pocket above, from which it can be discharged to locomotives by means of a chute. The entire pocket is carried on a balance, and by reading the weight before and after discharging the amount of coal issued can be ascertained. The plant is operated by a gasoline engine driving through a rope. There is a cinder pit near the coal plant for locomotives discharging cinders and ashes. The locomotive runs over a pit, one rail being carried on a girder supported on C. I. Standards and discharges its ashes beneath on to a concrete floor. At the side of this is a still lower pit into which cars can be run down an incline and the ashes can then be shovelled on to the cars in a very short time.

The water supply to the yard is dealt with by a combined Fairbanks windmill and water tank having a capacity of 50,000 gallons. From this tank a ten-inch main takes water to a ten-inch standpipe for watering locomotives, the standpipe being built in a concrete box. A 2-in. water supply to the coal plant and cinder pit for washing purposes is also taken from this ten-inch main. A four-inch main supplies water to the engine house to two hydrants and the boiler, and also to a fire hydrant outside the building. The tank is normally kept full by the windmill pump, which takes its water from the lake by a four-inch intake provided with a foot valve. In the event of the wind being insufficient a combined gasoline engine and pump has been installed in a small pump house for emergency purposes. The intake has been protected from damage by logs or ice by a guard crib built round it where it enters the lake.

Little Current Bridge—North abutment.

A complete drainage system has been put in, the surface water being taken from sumps at the coal plant cinder pit and standpipe by a 6-in. vitrified pipe which joins the drainage pipe from the sumps in the engine house pits and drop pit, the two pipes then discharging into an 8-in. vitrified pipe which falls to the lake. A trap is provided outside the engine house to prevent any gases passing into the building.

As the island is practically solid rock it will be seen that a large amount of rock excavation was necessary both for the cinder pit and coal plant and also for the trenches carrying the pipes for drainage and water.

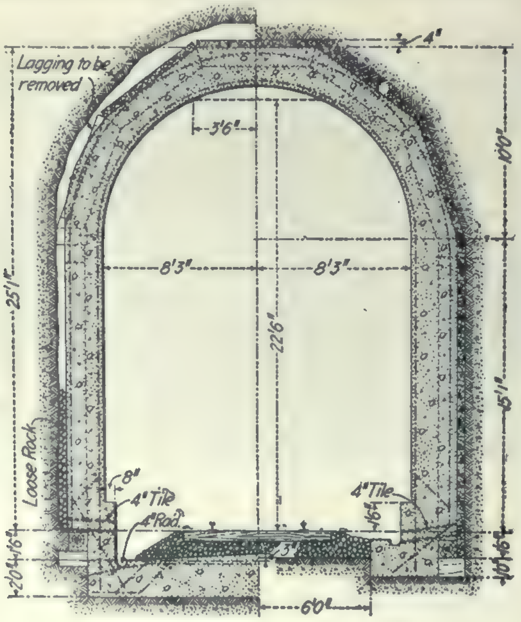
There are ample arrangements made for dealing with cattle in the form of pens both sides of the channel, and there is also siding accommodation for 120 45-ft. cars, and a Y for turning trains or locomotives.

The whole of this work, with the exception of the superstructure for the bridge and the coal plant, was carried out by the Foundation Company, Limited, of Montreal.

Tunnel Work on the Grand Trunk Pacific

Difficulties Encountered and Methods Employed in Finishing Nine Bores on the Transcontinental Line Through British Columbia

WHEN the preliminary work of driving the Grand Trunk Pacific tunnels in British Columbia had been completed "in the rough" and track laid so that construction and supply trains might pass on to the ever-advancing railhead there yet remained a difficult and expensive part of the tunnel work. This was the trimming up of the tunnels and the placing of permanent lining. On the line built eastward from Prince Rupert this work was started in September, 1912, and was not completed until February, 1914. It involved practically the same problems and difficulties that were met in driving the tunnels in the first place, with the additional factor of keeping the track clear for the passage of trains. There are eleven tunnels in this section of the road, of which two (Nos. 2 and 7) are in solid rock and required no lining. The remaining ones, which required to be lined with concrete, have a total length of about 6,500 ft.



Typical half-sections of tunnel lining.

Tunnel 1, at mile 44 east of Prince Rupert, was driven for use as a snowshed during the winter months, trains using the main line, which followed the contour of the hill outside, for eight or nine months of the year. The roof of this tunnel was found to be about 4 ft. too low to allow the placing of the lining which was finally considered necessary; but since the track outside could be used for traffic while the tunnel work was under way no great construction difficulties were experienced. The downhill side of the tunnel interior was also widened down to a level about 4 ft. above the track where the rock was benched and was used as a foundation for timber and concrete. About 30 ft. of concrete lining were required in the badly broken rock at the west portal.

At mile 103.7 the main line enters a 920-ft. tunnel, about half of which is in solid rock, and required no lining. At its eastern end, however, the tunnel emerges in material which is extremely troublesome when wet. One of the accompanying views shows the condition of the portal during the work, where, after many slides, timber cribs were built to prevent the mud from flowing over the track. It was decided that long wing walls would be required at the portal, and to secure substantial support for these a pile foundation was put in and the concrete was placed under the protection of a cofferdam. Although the soft material gave much trouble during the construction, once the work was completed it is said to have proved satisfactory in every way. The view of the completed portal indicates the successful operation of the subdrainage system.

Concrete-Mixing Plants

The concrete plant at this portal was arranged to be operated by two double-drum hoisting engines. One of these conveyed materials up an incline to bins over the concrete mixer, while the other handled cars loaded with concrete between the mixer and the desired point on the track. For use at this tunnel a temporary platform was fitted up on a standard flat car and provided with an incline leading up from track level. This was known as the "high car" and was moved from point to point in the tunnel, or drawn out for the passage of trains, by means of cables from the same stationary engine that operated the dump cars. When the dump cars had been charged at the mixers and conveyed to this "high car" at the point where work was in progress they were uncoupled and connected to a cable leading up the incline, operated by the engine as before. Thus the concrete was delivered at the desired point along the tunnel line on top of a platform high enough to allow it to be dumped into side wall forms or easily shovelled into the roof forms.

A typical plant for mixing concrete for tunnel lining is shown in the portal view of tunnel 4. This tunnel, at mile 104, is 550 ft. long, and the material traversed was so soft and broken that concrete lining was necessary throughout. Suitable space and materials for mixing concrete were found at the west portal, and the plant shown was therefore established there to supply the entire tunnel. Gravel was shovelled by hand into dump cars, shown at the left of the picture, which served as measuring boxes, each holding just enough for a batch. The cars loaded with gravel were hauled up the incline as far as the cement shed, under which they stopped long enough to receive the cement charge on top of the gravel, and were then hauled to the platform, where they were dumped into the mixer hopper as desired. The engine on the left of the track operated cars on the incline, while the one on the right hauled the concrete cars in and out of the tunnel. These cars operating in the tunnel used tracks laid on 12 x 12-in. timber framing shown, which had to be erected throughout the length of the tunnel to support loose rock and prevent a cave-in.

Difficulties in Relining

Perhaps the most difficult work on the line was in the 1,250-ft. tunnel at mile 104.5, which had to be timbered as fast as it was driven for more than 1,000 ft. of its length. All this original timber lining had to be removed to allow the final trimming up of the bore and the placing of the concrete lining. This proved to be dangerous work, because there was much loose rock behind the timbers. In this tunnel there was no alternate route, and the track had to be kept clear for the passage of trains. The method adopted was first to put in 12 x 12-in. angle braces from the side-wall posts to the tunnel floor just clear of the track. Excavation for permanent footings was then made, undermining the lower sills, while the angle braces carried the load. Concrete was then poured on foundations thus prepared and was left to harden with an offset for temporary timbering.

On the offset of the permanent footings temporary bents of 12 x 12-in. timbers were built, similar to those shown in the portal view of tunnel 4, these bents being of such size as to give sufficient clearance for trains and at the same time leave room for the lining-forms. The roof timbers were then supported on these temporary bents, while original posts, sills and wall plates were removed, and the forms placed and filled up to the springing line of the arch. In some places the nature of the material was such that it was safe to remove the timbering and pour side-wall sections as long as 48 ft. at a time, while in other parts of the tunnel the ground was so heavy that 4-ft. sections were as long as could be handled with safety. After the concrete walls had set the roof timbers were removed, a section at a time. The arch was concreted by a similar process. The roof sections gave more trouble than the walls, and the lengths deemed safe without timbering varied from 3 to 32 feet.

Concrete was handled in this tunnel by the use of a "high car" similar to that already described, except that here a short incline led from the "high-car" platform to the top of the temporary bents, from which concrete was dumped into side walls or shoveled into roof forms.

The reinforcing in the concrete lining varied with the material traversed, but a typical case in gravel and clay was given a double row of ⅞-in. round bars placed on 6-in. centres and extending from the footing on one side over the arch to the footing on the opposite side. The horizontal bars were ⅝ in. in diameter and were placed on 5-ft. centres. Splices were required to have a 4-ft. lap and be firmly wrapped with wire. Where soil conditions required, the invert was floored with concrete, or concrete struts 4 ft. wide were placed on 12-ft. centres.

The trimming-up and lining of tunnels 1, 3, 4, 5, 6 and 8 were under the supervision of F. R. Giertsen and that of tunnels 9, 10 and 11 under the supervision of G. C. Mulville, assistant engineers, Grand Trunk Pacific Railway. Contracts for all this work were held by the Bates & Rogers Construction Company, of Chicago and Spokane, for whom R. J. Graham was superintendent.

Sheet asphalt for the middle section of the street and brick pavement on the sides and gutters—is suggested by the City Solicitor of Hamilton, Ohio, as a solution of that city's paving problem. It is claimed that this type of pavement has proved successful in other cities.

The National Paving Brick Manufacturers' Association will hold their eleventh annual convention at Buffalo, N.Y., September 9-11 next. Mr. W. P. Blair, 832 Brotherhood of Locomotive Engineers' Building, is the secretary.

Mining Operations in Quebec

According to the returns received by the Quebec Mines Branch, the value of the products of the mines and quarries of the province reached a total of $13,119,811 during the year ending December 31st, 1913. It is the highest annual production recorded to date and exceeds that of 1912 by $1,932,701, or a proportional increase of 17 per cent.

The structural materials appear for a preponderating part of the total value of the mineral production of the Province of Quebec. In 1913, their value amounted to $8,187,917, which represents 62 per cent. of the total production. Under this heading are grouped cement, limestone, brick, granite, lime, building sand, clay products (tiles, drains, pottery, etc.) in the order of their importance.

Cement.—The cement manufactured in the Province of Quebec is exclusively Portland cement. The manufacture of cement is now an exact science, and it is almost impossible to find a natural mixture of clay and limestone which will give the results expected from a Portland cement. The natural cement industry in Canada has been entirely replaced by the manufacture of Portland cement, in which the raw materials are mixed in fixed proportions, according to a strict chemical control.

The composition of Portland cement is therefore definite, and although the mixture of raw materials may vary within narrow limits, it should normally contain 75 per cent. of lime carbonate, 13 per cent. silica (soluble), 5 per cent. alumina, 1½ per cent. iron oxide (Fe_2O_3), and the remainder allowed for impurities, magnesium carbonate, alkalies and inert substances. The raw materials used in the Province of Quebec are Trenton limestone exclusively, for the lime constituent, and Utica shale, or Leda marine clay, for the argillaceous component. These substances are very abundant. All along the north shore of the St. Lawrence river deposits of both limestones and clays are common.

In 1913, the cement mills of the Province of Quebec shipped 2,881,480 barrels, valued at $3,361,292. In fact, the value of the cement production was over 40 per cent. of the total value of the structural materials. Ten years ago, in 1904, the recorded production of cement of our province was 40,000 barrels, valued at $66,000.

Limestone.—The limestone industry is well developed in the vicinity of Montreal, where quarries have been opened at Mile End, at Outremont, Cote St. Louis, Longue Pointe, Villeray, Sault-au-Recollet, on beds of the Chazy and the Trenton limestones, both of which are well developed in the Island of Montreal.

At St. Vincent de Paul, St. Francois de Sales, where a great deal of the limestone is produced, the quarries are in the Trenton. The same formation is also worked at St. Marie des Carrieres, Deschambault and Lachevrotiere, in Portneuf county, as well as at Beauport and Chateau Richer, immediately below Quebec. Trenton limestone is also quarried in Hull, opposite Ottawa.

From returns received from producers, the limestone extracted in 1913 reached a value of $1,704,207. This, however, does not represent the whole production, for it is almost impossible to keep track of all the small operators who work spasmodically. From the 162 names of limestone producers to whom we sent return forms to be filled in, only 84 answers were received, many answering only after the second or third request. Of these 84, there were 44 who reported a production, and 40 whose quarries had been idle during the year.

Granite.—The Laurentian area, which extends to the north of the Ottawa and St. Lawrence rivers, affords an unlimited supply of granites of various colours and textures, but owing to the limited market, very few quarries have been opened. The main operators in the Laurentian granite are the Laurentian Granite Company, whose quarry is situated at Staynerville, in the county of Argenteuil; M. P. and J. T. Davis, who are working a quarry at Riviere a Pierre, north of Quebec, the stone being used altogether in the construction of the Quebec bridge.

Another source of granite is found in the various igneous intrusions which penetrate the rocks of Ordovician age in the Eastern townships, and large quarries on such occurrences are worked in the township of Stanstead; in the township of Whitton; on Mount Johnson, near Iberville Junction. The production of granite reached $496,588 in 1913, as compared with $358,749 in 1912.

There are no new developments in the other materials of construction. Brick and lime show very small increases as compared with the previous year, which may be accounted for by the fact that concrete construction is on the increase, as shown by the large increase in the production of cement. The sand which figures in the table of production only represents a very small proportion of the sand actually used in building operations, as we only keep record of the sand which is worked under mining licenses. Most of this sand is dredged or pumped from the beds of rivers.

Garbage Incinerators and Destructors

By Sterling H. Bunnell, New York City

The author of this article is experienced in the solution of garbage disposal problems and here shows the fields of garbage reduction and of garbage and waste destruction. He then describes the processes in the modern English type of refuse destructor, with references to various plants in operation.

THE disposal of the garbage and refuse of cities is becoming one of the great problems of municipal life. In the early stages of a city's growth the rubbish and refuse is usually dumped in hollow places or on low lands, and serves as filling material. As the city increases in size the amount of refuse increases in proportion and land becomes less accessible from the thickly settled parts of the town. A rubbish dump creates a nuisance, is a menace to health, and a fire risk as well; while the dumping of garbage along with refuse increases the nuisance ten-fold. The garbage disposal problem generally comes up as one of the serious questions before the city authorities long before the city has grown to what may be called large size.

The waste of cities may be divided into three classes: Garbage, comprising putrescible refuse, table scraps, commission house offal and other waste from food substances, to which is occasionally added the carcass of a dead animal. Ashes from house fires and factory furnaces are produced in large quantities, and comprise the only form of city waste which can be safely used in filling low ground. Ashes can also be used to some extent in road surfacing in the suburbs. The third class of waste is dry rubbish, comprising waste wood, sweepings, lawn cuttings, branches from shrubbery, paper, rags, old shoes and other cast-off articles.

The three classes of waste, if obtained in sufficient quantities, can be advantageously treated separately. In cities of large size, where the class of garbage alone amounts to one hundred tons or upwards per day of twenty-four hours, the reduction system has many advantages. The garbage is collected in steel wagons, delivered to a reduction plant situated at a proper distance from the thickly settled portions of the city, and there converted by cooking and pressing processes into grease and tankage. In these operations a large quantity of stick-water is produced, which, if allowed to run to waste, creates a nuisance and is extremely unsanitary and objectionable. In order to dispose of the stick-water, which carries a considerable percentage of material which can be recovered as tankage, it is necessary to provide evaporators and to drive off the water as harmless steam, while the stick-water is concentrated into thick tankage and added to the product of the plant.

The products of a reduction plant are: grease, which may be classified, refined, and separated into various grades and sold for making soap and for other purposes; and tankage, which is useful in manufacturing fertilizer. If the operation is carried out on a sufficiently large scale, stated above to be not less than 100 tons per day, the profit is likely to be sufficient to make an attractive return on capital. In smaller quantities the reduction operation is almost sure to show a loss, unless all attempt to carry on the process inoffensively is abandoned and the foul and putrelying stick-water allowed to run away in the nearest stream. Small cities operating reduction plants are invariably burdened with a serious nuisance, as can be readily verified by inquiry among the inhabitants of such places.

The situation with regard to disposal of municipal wastes came to a crisis in Europe some years ago. In consequence, the most advanced methods of waste disposal originated across the ocean. The inhabitants of European cities waste far less of their food material than is the practice on this continent, so that the quantity of garbage per inhabitant is extremely small, and its value for reduction purposes is slight. There being no incentive, therefore, to separate garbage from other wastes, the plan was adopted of destroying the mixed refuse of the city in large high-temperature furnaces. The English destructor system by which the entire waste collection of a city, or a portion of the city, is delivered to a destructor plant, and there burned under forced draft, in connection with steam boilers by which power is obtained from the waste heat, has now been widely adopted by cities throughout the world.

Many of our cities have as yet done nothing in the direction of the sanitary disposal of municipal waste. Owing to the large free spaces which surround the smaller cities, it has usually been possible to carry on dumping operations, or feed the garbage to pigs, and to change the location of dumps when conditions become unbearable. Comparatively few of the smaller cities have been forced to instal incinerators for destroying garbage, or reduction plants for utilizing its values. But the time has already come when the conditions have become so serious that many cities are studying the best solution of the waste disposal problem. Since the reduction plant cannot be operated on a small scale without nuisance, except at a heavy cost for operation and maintenance, the simplicity and convenience of the incinerator makes the latter the only feasible apparatus for waste disposal in small cities.

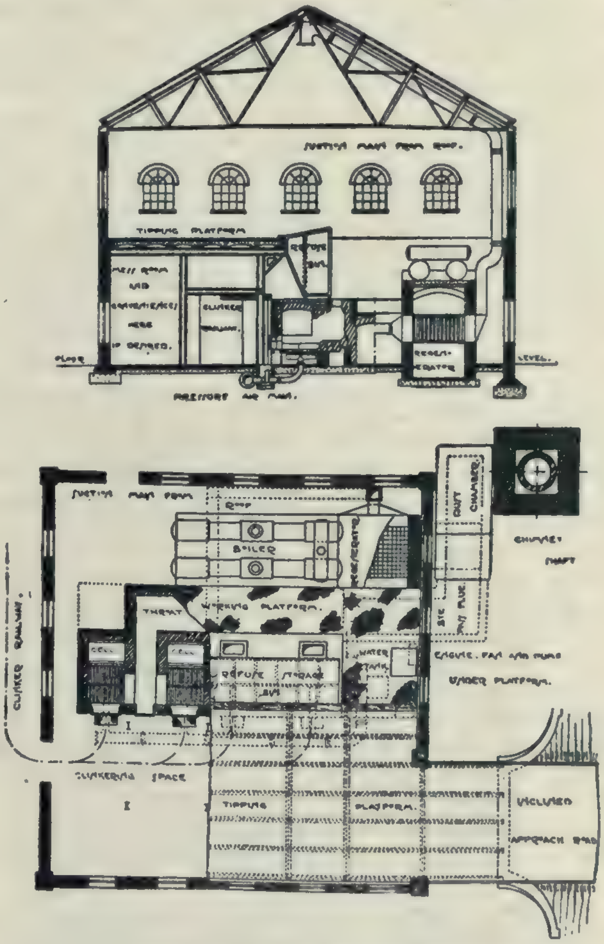
Incinerators are intended to deal with garbage and rubbish as collected, and not to handle ashes or large quantities of non-combustible material. Two kinds of incinerators may be recognized. One attempts to provide storage space within the furnace for the entire day's collection of garbage, and to dry the wet mass slowly by heat previously accumulated in the furnace walls, and supplied by a coal or oil fire kept up in a combustion chamber below the material. The system has the advantage of taking the entire day's collections at one time, thereby reducing the time and labor at the plant. Its disadvantage is the impossibility of maintaining in the presence of the mass of wet material temperature sufficient to destroy the noxious odors. Incinerator plants of this character should be provided with tall chimneys, and are never safely located within the limits of a settled portion of the city.

Incinerator furnaces operating at high temperature have been successfully installed and operated in a number of cities. Such furnaces are constructed of fire-brick throughout. They provide a fire-brick surface on which the garbage and refuse may be charged in reasonable quantities at intervals of thirty to sixty minutes, and a fire grate on which quick combustion, at high temperature, may be kept up by firing the dry rubbish collected along with the garbage, or using coal or other fuel if the quantity of rubbish is deficient, or the collection too wet on account of rain. In the brick-lined destructor furnace it is possible to keep up a temperature above 1,250 degrees, and thereby to destroy organic gases and positively prevent the escape of disagreeable odors from the plant.

Destructor furnaces may be used in connection with steam boilers, if desired, and steam power may thus be developed for any useful purpose. In this way large department stores and city buildings may utilize the waste material which is collectible in large quantities, and supply steam to the power plant of the building. Large works may dispose of rubbish of all kinds, including sweepings, restaurant scraps and every form of combustible waste, whether wet or dry, while realizing from the waste heat a large amount of steam power. In cities and towns up to populations of 25,000, destructor furnaces with steam boilers in connection, may provide power for municipal lighting, for sewage pumping, or for the heating of city buildings and other useful purposes.

Where the quantity of rubbish and garbage collected reaches upwards of one hundred tons per day of twenty-four hours, the English destructor system has marked advantages. The destructor receives and destroys all material collected, making it unnecessary to separate garbage from refuse and ashes, and requiring only one collection instead of three. The temperature at which the material is destroyed precludes the possibility of creating a nuisance in the neghborhood. In the City of London, the Borough of Bermondsey has a destructor installed in a city block containing a school, a city building, a library and a number of residences, and surrounded by closely built blocks of residences on three sides. This particular destructor is now operating after some fifteen years use, at greater capacity than originally intended and is receiving the refuse collections from an adjacent borough as well as its own regular collections.

The high-temperature destructor consists of two or more separate cells or furnaces, each provided with a grate and a drying hearth at the rear. The forced draft is supplied to each cell by a perforated air pipe opening in the ash pit. The gases of combustion pass through the cells from one to the next and enter a combustion chamber, in which the temperature may go as high as 2,500 degrees. From the combustion chamber the gases are led through the heating passages of a steam boiler, thence through a regenerator or air heater and to the stack. The air for forced draft is taken generally from the roof spaces of the destructor house, thus providing efficient ventilation and means for the removal of dust. The ventilating ducts lead to the intake side of a pressure fan, by which the air is forced through the heating passages of the regenerator and thence through air pipes controlled by convenient valves to the perforated discharge pipes under the grates.



Plan and cross-section of Sterling refuse and garbage destructor at Berkeley, Cal.

In the operation of a destructor, the garbage, refuse and ashes, mixed as received from the collecting wagons, is fired, either through charging holes in the top of each cell, closed by sliding covers lined with fire brick, or through doors in the back wall of each cell. The damp material falls on the drying hearth referred to previously, and is acted upon by the heat from the material burning furiously on the grate surface in front of the drying hearth. In this way vapor and fumes are driven off and consumed thoroughly in the passage through cells and combustion chamber. As the material on the drying hearth becomes dry, it takes fire and commences to burn rapidly. The stokers now pull forward the charge from the drying hearth and spread it over the grates, and introduce a new charge of fresh material upon the drying hearth.

The cells are operated alternately, so that one is always burning brightly while another is being charged. In this way there is always sufficient heat and flame to destroy the escaping odors and vapors. As the material burns on the grates it forms a hard clinker, which must be removed from time to time by stoking.

Mechanical charging and clinkering devices have been developed with more or less success, for use in the larger plants. The most convenient method for stoking the garbage into the furnaces is the top-feeding system. The building for this method is preferably constructed against a side hill, on which a road can be laid giving access for wagons to the second or dumping floor of the building. The garbage in this way is dropped into hoppers above the furnace and raked from these hoppers into the charging cells as required. During the operation of charging, the blast must be shut off from the cell being charged, or flames may issue from the charging hole and ignite material in the hopper. To prevent such accidents, and for greater convenience in charging, mechanical charging mechanism has been developed, by which material required for one charge of a furnace is first placed in a container or bucket, which at the proper time is moved over the charging opening, the cover of the opening withdrawn, and the material allowed to fall into the cell below without handling or delay.

Where the top-charging system is not convenient, because no side hill is at hand and an inclined runway is not wanted, the garbage carts may dump on the floor level of the building, and the material may be carried by a grab bucket and crane from the receiving hopper to the charging containers above the furnace. A simpler method is to dump each garbage cart into a skip running on an inclined track. After receiving a load of garbage, the skip is hoisted by machinery to the top of the building and there dumped into a charging hopper, from which it is raked into the furnaces as required.

Clinkering a destructor furnace is generally performed by hand, and is an extremely difficult operation to perform by machinery. Destructor furnaces commonly receive all kinds of waste materials, including pieces of wire, nails, glass, iron rods and other articles which often lock in the grate spaces or melt and run into solid masses of clinker, difficult to dislodge except by direct attack with a slice bar and poker. One method of mechanical clinkering is to provide the furnace with grates constructed in the form of a trough, and to lay in this trough a zig-zag iron bar which will become incorporated in the mass of clinker. When a large body of clinker is formed, a wire rope from a small windlass is hooked to a ring in the end of the bar and the whole mass drawn forward out of the furnace onto a steel car and thereby taken out of the building. Another method of clinkering is to provide a hydraulic plunger in the back of the furnace. By moving the plunger forward, the mass of clinker will be lifted and shoved out of the furnace to fall in the clinker car. Various forms of dumping grates have also been tried. But, at the present time, none of the mechanical systems of clinkering is in successful operation in the United States. The difficulties in the way of clinkering mechanism, through the presence of foreign substances in the clinker, and the general difficulty of removing heavy masses of molten clinker and ash, have been insurmountable.

Destructor furnaces of the English type are in operation in a number of cities on this continent, among which may be mentioned Montreal and Halifax, the borough of Richmond in New York, Paterson, N.J., Pittsburgh, Pa., Berkeley, Cal., and others. There are several large plants under construction or test, and the use of the system will undoubtedly increase rapidly in the near future. Many cities are inquiring to-day for information regarding the plants already in operation, and much interest has been aroused by the performances of the many successful plants.

A destructor plant, housed in a neat and handsome building, is a source of pride to the municipality owning it. No nuisance whatever occurs from the operation of such a plant, if well managed. Deterioration is not rapid, nor is the apparatus complicated and difficult to handle. Ordinary laborers are easily taught to be successful stokers in such plants. By proper planning in advance, a destructor plant may always be located on a site conveniently near the centre of the collection district and at a point where the steam produced, or electricity generated by engines operated with the steam from the destructor boiler, may be used by the city or sold to adjoining private parties. In many cases the operation of destructors is found to be a source of profit sufficient to cover the cost of collecting garbage. As between the filthy and unsanitary method of dumping the garbage and rubbish collections on vacant lots, or feeding pigs in municipal pens, and the efficient and sanitary disposal of rubbish and garbage in destructor plants, the choice is all in favor of the destructor system, and this system is the only one which can afford a profit in cities of moderate size.

The larger cities, in which the collection of garbage alone reaches seventy-five to one hundred tons a day, may with advantage consider the establishment of three collections, and the separate disposal of garbage, ashes and combustible rubbish. In these cities, a destructor finds employment for burning the unsaleable waste rubbish, as in the cities of Pittsburgh and Buffalo. Ashes being disposed of by dumping, and garbage by shipment to a reduction plant, the remaining rubbish can be sorted over a picking belt and separated into salable and unsalable portions. The worthless rubbish burned in high-temperature destructors furnishes power for the operation of the picking belt, and a surplus of electricity for lighting and for sale to other plants in the neighborhood. A further economy is possible. This is to utilize the worthless combustible refuse for furnishing heat to the reduction plant. This may be done either by baling the worthless refuse after sorting, and shipping it to the garbage plant, for which purpose it would be worth as much as coal at $2 per ton; or by delivering all the rubbish to the reduction plant, and there picking out the salable portions. In the average city collections, there is enough heat obtainable from the rubbish to provide most of the heat necessary in the reduction operation.—Municipal Engineering.

Calcium Hypochlorite as a Water Disinfectant

By E. J. Tully, Chemist, State Hygiene Laboratory, University of Wisconsin, Madison, Wis.

IN a study of the effects of calcium hypochlorite upon water when used as a disinfectant, the author experimented upon the clear public well water supply of Madison, Wis., the waters of Lake Mendota, Michigan, and Winnebago, with varying degrees of turbidity and pollution. He also tested the amount of hypochlorite which would leave a taste or an odor in the clear city water and in Lake Mendota water, using the testimony of several persons on various samples after various periods had elapsed, 1 to 48 hours after treatment. The summary and the conclusions he draws from these experiments are as follows:

Chemical disinfection offers a means whereby a very satisfactory purification of a water may be accomplished. Comparisons on a cost basis of the methods of chemical disinfection mentioned make it apparent that calcium hypochlorite is the most satisfactory and efficient agent at the present time for water disinfection.

The amount of organic matter in the water practically determines the quantity of calcium hypochlorite that it is necessary to use. As a general rule, practical sterilization may be accomplished by the application of from 0.1 to 1 part per million of available chlorin, but occasionally concentrations of 2 and 3 parts per million of available chlorin are necessary to effect desirable results with rather highly colored and turbid waters.

The removal of B. coli and intestinal organisms is usually more complete than that of the total organisms. Under the conditions of the laboratory experiments, the results of hypochlorite disinfection on typhoid organisms and intestinal bacteria in the various waters were practically identical. It is, therefore, safe to assume that the viability of pathogenic bacteria under working conditions in practical water disinfection is no greater than that of the typhoid organism, or intestinal bacteria as a whole. Consequently, the disinfection effected by calcium hypochlorite relative to the total bacterial removal may be referred directly to pathogenic bacteria with assurance of reasonable accuracy.

The slight odor and taste of chlorin imparted with somewhat more than 0.5 part per million is applied disappears in a short time, leaving the water entirely acceptable from a sanitary standpoint, and, as the hardness is not materially increased by the application of the usual small quantities employed, the treated water is not rendered unsuitable for industrial purposes.

There is no apparent reason for believing that the results are not of general applicability. The reactions involved are particularly free from interference on the part of the mineral constituents of normal waters; and normal variations of temperature have practically no effect on the final results. The efficiency of the process is also entirely independent of the secondary or after growth of harmless resistant organisms.

The calcium hypochlorite process of sterilizing water combines the desirable qualities of economy and efficiency, and affords cities and towns, which are unable financially to build a filtration plant, but are forced for sanitary reasons to adopt some method of purification, a means of insuring a safe water supply. It may be used to advantage in cases of emergency, where either filtered or unfiltered supplies have become infected and where it is difficult to cease using such supplies. Where mechanical filtration is not sufficient to render a water safe, treatment with calcium hypochlorite offers an excellent method of sterilization and is especially applicable in such cases.

July Building Returns Show Increase

THE building returns to date point to the fact that the volume of construction work planned during July was in the majority of cases greater than it was for the corresponding month of last year. The value of permits in Montreal was nearly a million dollars higher than in July of 1913 and brings the total for the year to date to over eleven million dollars. Toronto's figures ($2,320,835 for July, 1914, and $3,922,911 for July, 1913), on the other hand, were smaller than the exceptional record twelve months ago when two permits alone involved over two million dollars. At St. John, New Brunswick, only eighteen permits were issued, though the value of the buildings planned was over a hundred thousand dollars. Other cities in the Eastern provinces which passed plans representing a greater value than last year were Maisonneuve and Hamilton. Only a few returns are as yet to hand from the West and of these Winnipeg reports high figures—nearly double of those of last year. Regina is the only other city to show any substantial increase.

A wagon-loading machine for dry brick clay is employed by the Hydraulic-Press Brick Company, of St. Louis, Mo., in gathering the clay for its plant. Special plows hauled by traction engines turn up the top of the field to a depth of 1½ ins., the teeth of the plow being so set that each turns up a strip about 4 x 1½ ins. This strip curls over and breaks into pieces 4 to 8 ins. long as it falls from the plow. The entire field is plowed in this way and left to dry for 12 to 24 hours, according to the weather. The wagon loader has a four-wheeled wagon bed, surmounted by an enclosed vertical frame or tower within which works a vertical bucket conveyor, having long buckets. The lower end of the conveyor comes close to the ground and just in front of it is an apron which gathers up the clay so that it is within reach of the buckets. At the top, the buckets dump their contents into an inclined chute projecting from the side of the tower and discharging the clay into wagons which are driven alongside the machine as it travels across the field. The elevating conveyor is driven by a sprocket chain from one of the rear wheels, and the machine is hauled by a team of six mules. The plows and wagon loaders are of the company's design and are built in its own shops.

Erie, Pa., metered 31.3 per cent of the water consumed in 1913, which amounted to 144 gal. per capita for the 80,000 people served through 18,091 taps. Bacteria, according to the annual waterworks report, in water treated with 7.35 lb. per million gallons averaged 37 per cubic centimeter with maximum and minimum months of 60 and 18. Odor gave trouble only once, and that due to chilled water in December causing a slow reaction. 8he turbidity of the water settled one and one-half days varied in monthly averages from 4 to 33 parts per million, a removal of from 20 to 46.6 per cent.

Sewage Disinfection in Actual Practice

Observations Based on the Operation of Twenty Plants in New Jersey Using Calcium Hypochlorite as a Disinfectant

By William J. Orchard*

DURING the last six years the disinfection of sewage and sewage effluents as a practical form of sewage treatment has come to be adopted by a great many towns and municipalities. The growth of this form of treatment has been rapid, and present indications tend to show that its growth will be even more rapid in the future.

Much of the credit for the development of this process is due to Prof. Earle B. Phelps, now connected with the U. S. Public Health Service, who demonstrated in 1907 and 1908 that calcium hypochlorite was a practical and economical disinfecting agent as far as sewage and sewage effluents were concerned. Prof. Phelps carried on very extensive experiments at the Massachusetts Institute of Technology, Boston, at Red Bank, N.J., and at Baltimore, and the results of this work are very ably presented in Water Supply Paper 229 of the U. S. Geological Survey, reproduced in a recent issue of the Engineering Record.

As a result of the pioneer work of Prof. Earle B. Phelps there are now twenty sewage-treatment plants in the State of New Jersey at which calcium hypochlorite is used as a disinfectant, and several more are under construction or planned. Of the plants in operation eighteen are for the disinfection of sewage that has received more or less preliminary sedimentation. One is for the disinfection of a contact-bed effluent, and one for the disinfection of the effluent from natural sand beds.

Some of these plants are visited by representatives of the New Jersey State Board of Health once a month and the others once every two or three months, so that every disinfection plant in the State is visited at least four times a year. A great many visits to these plants have led to the conclusion that in actual practice the disinfection of sewage presents difficulties not encountered in experimental work and probably not appreciated by the casual observer. These difficulties are not due to any inherent defect in the process but are directly attributable either to faulty design or to improper or unintelligent operation.

Purpose of Disinfection

Sewage disinfection is resorted to generally as a practical and more or less economical means of preventing undue pollution of either water supplies, shellfish beds, or bathing beaches. If the disinfection is irregular and unreliable and does not destroy within the limits of practical disinfection the pathogenic bacteria in the sewage, the disinfection plant has fallen short of the purpose for which it was installed, and the consumers of the water, the shellfish, and the bathers at the beaches are unduly exposed to disease. That many of the disinfection plants at present in operation do fall short of the purpose for which they were installed is a regrettable fact.

Most of the trouble seems to be due to the shortsightedness of the designing engineer in not first experimenting with the sewage to be treated, and so designing the plant that the period of contact between the sewage or sewage effluent and the disinfecting agent will be sufficient to secure a reasonable bacterial reduction when a reasonable amount of disinfectant is used. Another reason for these plants not coming up to expectation is because as yet there has not been designed a dosing device that under actual working conditions is dependable and at the same time flexible enough to increase or decrease automatically the flow of hypochlorite solution as the flow of sewage increases or decreases.

Proper Period of Contact

To illustrate these two points, a description of the conditions found to exist at a plant spoken of here as Plant A is given. At this plant the hypochlorite solution is added to sewage receiving such a short preliminary sedimentation that it might almost be spoken of as crude sewage. To this sewage it was planned to apply sufficient hypochlorite solution to secure a dose of 13 parts per million of available chlorine, and a short supplementary contact period was provided for. The purpose of applying the disinfectant was to protect shellfish and bathing beaches. The hypochlorite solution is applied through a patented device in which the dose depends upon the depth of immersion of a small rectangular orifice in a constant level dosing box. This depth of immersion increases with an increase in the amount of sewage arriving at the plant. The device is not dependable, however, because the orifice is so small that it becomes readily clogged by particles of undissolved bleach and by pieces of the scum or scale which sometimes forms on the surface of a tank of hypochlorite solution. At one visit it was found that the orifice became clogged six times within one hour, and until the clogging was removed the flow of hypochlorite solution cease. Under these conditions it was determined that the dose of available chlorine instead of being 13 parts per million was 2.3 parts per million. By means of dye it was demonstrated that only 4½ minutes elapsed from the time the disinfecting solution was applied to the sewage until the sewage was discharged through the outfall into the stream. At every visit B. coli by the presumptive test has been indicated in 0.001 cu. cm. of the discharged effluent and in some cases in 0.0001 cu. cm.

Insufficient Operating Directions

At some plants much trouble is due to the designing engineer leaving the plant upon its completion without giving proper instructions regarding its operation. A case in point is Plant B, a relatively new plant embodying some commendable features of design. It is so arranged that the hypochlorite solution may be added to the sewage in its crude state, or after periods of sedimentation ranging from 1 to 4 hours. It is a very flexible installation, from which exceptionally good results can reasonably be expected.

The designing engineer left the plant upon its completion without giving directions regarding its operation. The local sewer committee appointed a member of the city police force as the attendant of the plant and he was required to visit the disinfection house twice a day, mix up the bleach solution and keep the pipes and orifices free from deposit. About six weeks after the plant was put into operation a representative of the State Board of Health visited it and found that the hypochlorite solution, instead of being added to the sewage, was flowing through a series of petcocks into a trough connecting the various sections of the sedimentation tank. The outlets from this trough were all tightly closed by stop-planks and the hypochlorite solution was simply storing up in the trough and absolutely no disinfection was accomplished. All of the bleach that had been used in the previous six weeks had been wasted.

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* Assistant Sanitary Engineer, New Jersey State Board of Health, Trenton.

Machinery in Disinfection House

Another difficulty often encountered at disinfection plants is due to the designing engineer placing pumping machinery in the disinfection house, where it is exposed to the corrosive action of calcium hypochlorite fumes. Any article of iron or steel which comes in contact with these fumes rapidly disintegrates and in a relatively short time must be replaced. Conditions found at Plant C illustrate this point. This plant is an installation for applying hypochlorite solution to a sewage that has received very satisfactory sedimentation and was built to protect shellfish beds. There is a high and low level sewer system, and the machinery for lifting the low-level sewage up into the sedimentation tanks was placed in the building in which the hypochlorite was stored, mixed and applied to the sewage. This machinery consisted of electric motors, gas engines, displacement pumps, air compressors, ejectors, etc.

The low-level system was not put into use until the plant had been running for more than a year, due to a broken trunk sewer under a stream. This sewer was repaired and the low-level sewage arrived at the plant. It was found, however, that the machinery could not be started, and an examination showed that every exposed part of each unit had corroded to an unbelievable extent. Even the leather belts had become so hardened that they split when bent, and in some cases gaskets, bushings and washers had entirely disintegrated. The low-level sewage was rapidly backing up throughout the system, however, and after a liberal application of oil the electric motors were started, with the result that they both were burned out. It was necessary to bypass the low-level sewage for several months before repairs could be made, and the machinery had to be housed in a separate building.

Ignorance of Plant Attendants

Lack of ability and knowledge on the part of the plant attendant is responsible for most of the troubles at disinfection plants. Municipal officials seem to have the idea that sewage disposal must be associated with dirt and stench and filth and that a common laborer is the man to take care of a plant.

The need of intelligent, trained attendants at all sewage-disposal plants is growing more apparent daily. Particularly is this so in the case of disinfection plants. At these plants a man must be on the job every day to mix the hypochlorite solution, clean the dosing apparatus, and keep the plant in working order. At a sewage-disposal plant of any other type a man might occasionally take a day off without seriously affecting the operation of the plant. At a disinfection plant, however, the least neglect always causes trouble, for either the hypochlorite solution will become exhausted or the dosing device will become clogged, and in either case disinfection ceases.

To illustrate the ignorance of plant attendants the following conditions found at plant D are described. Plant D is a disinfection plant installed for treating a sewage effluent which is discharged into a water supply that is filtered before it is distributed to the consumers. The necessary daily amount of calcium hypochlorite to be used was determined as 30 lb. The attendant was advised to mix the solution daily and keep a constant flow. A subsequent inspection showed that the attendant carefully weighed out 30 lb. of hypochlorite every morning and dumped it into the mixing tanks. He then opened a spigot to fill the tank and at the same time opened the outlet. Water was allowed to run into the tank continuously, with the result that the bleach was soon dissolved. In the early morning the dose of disinfectant applied to the sewage was excessive, but it gradually reduced throughout the day until in the afternoon it was negligible. Tests made at noon showed B. coli to be present in 0.01 cu. cm. of the final effluent.

Politics and Sewage

To further illustrate the carelessness of plant attendants and the effect of municipal politics upon the operation of sewage-disinfection plants a description is given of conditions found at plant E.

This plant was installed to protect shell-fish beds, and the hypochlorite solution is added to a well-clarified sewage effluent. At the time the plant was put in operation the superintendent of sewers was not a trained man and he assigned a street laborer as the plant attendant. He was allowed one hour in the morning and one hour in the evening to visit the disinfection house and mix up the hypochlorite solution. The flow of this solution is controlled by hand-regulated pet-cocks.

Shortly after the plant was put into operation an inspection was made, and it was found that the hypochlorite solution was all allowed to run out in a few hours and that for the remainder of the day no disinfectant was added to the sewage. At one visit it was found that the dose of available chlorine was 11 parts per million for 13 hours, but that for the remaining 11 hours of the day no hypochlorite solution was applied. While these conditions existed weekly inspections were made, but the importance of the matter was not appreciated by the superintendent and he refused to have the attendant take sufficient time to adjust the flow of hypochlorite properly. At many visits B. coli was found to be present in 0.00001 cu. cm. of the final effluent.

These unsatisfactory conditions continued for a few months and then a political upheaval occurred and a new superintendent of sewers was appointed. This man was a trained sanitarian who appreciated the importance of sewage disposal, and the operation of plant E under his supervision was greatly improved. The same laborer was instructed regarding the operation of the plant and was required to spend his entire time taking care of it. The dose of hypochlorite was regulated and the effluent was much more satisfactory. These better conditions continued for a year and then another political change occurred, the sanitarian was discharged and a new superintendent of sewers was appointed. He was not a trained man and took the same attitude as the sanitarian's predecessor, with the result that as far as the State Board of Health was concerned the work of securing proper operation had to be done all over again. At the last three inspections the dose of available chlorine has been 6, 2.3, and 4 parts per million, and in two cases B. coli was present in 0.0001 cu. cm. of the final effluent, and in one case in 0.00001 cu. cm.

Irresponsibility of Attendants

Another matter which enters into the operation of disinfection plants is the utter lack of appreciation of moral responsibility on the part of those in charge of the plant. For instance, plant F is an installation for disinfecting a contact-bed effluent. The final effluent is discharged into a relatively small stream, and 2 miles below the outfall is the intake of a water supply, which receives no treatment whatever. This is clearly a case where those in charge of the disinfection plant are morally required to exert their best efforts to protect the consumers of the water into which the effluent discharges. Repeated inspections have been made, however, when it has been found that absolutely no hypochlorite was being applied and B. coli was present in 0.001 cu. cm. of the final effluent. The superintendent of the plant has absolutely disregarded the requests and orders of the State Board of Health, and legal steps have been taken to compel him to operate the plant so that a satisfactorily purified effluent will be discharged. The process of the law is so slow, however, that a water-borne epidemic may break out in the town before the necessary legal steps have been taken. If such an epidemic should occur the negligent superintendent would certainly be morally responsible.

The cases cited are only typical of the general condition of disinfection plants. Almost every plant might be here described and used to illustrate some points of defective design or operation. George W. Fuller in the concluding paragraph of his book, "Sewage Disposal," says: . . . "If increased faithfulness is not given to the proper operation of sewage-disposal works it is only a question of time when steps should and will be taken by the State authorities in the more thickly populated sections of the country to make compulsory the proper management of sewage-disposal works."

Central Supervising Authority

With disinfection plants it surely is only a question of time, and the day probably is not far distant when the central supervising authority will be given more power to secure the discharge of a proper effluent and more workable laws to enforce this power. When this power is secured it will probably be necessary to adopt standards which the effluents must measure up to before discharging.

The adoption of such standards presents many obvious difficulties. As a basis of comparison the presence of B. coli in definite quantities of the effluent will probably be used, and the standard will be expressed as not more than a certain number of B. coli in a liter. If such a method is adopted no arbitrary standard could apply to every disinfection plant, and each case would have to be studied and a standard adopted in harmony with the controlling factors.

Among factors which should be considered in the case of an effluent discharging into a water supply might be mentioned the normal dilution afforded by the stream, the distance of the outfall from a water intake, and the measures taken to purify the water supply.

In the case of a disinfection plant discharging an effluent into water near shellfish beds it will be necessary, before standards are adopted, to determine the dilution factor and consider the stream or ocean currents tending to carry the sewage effluent to the shellfish areas. In the case of oyster beds, if the hibernation theory is accepted it will be necessary in every case to determine what allowance should be made during the season of hibernation, and when this season begins and ends.

The whole matter of adopting standards for the effluents from sewage-disinfection plants is one that will probably not be developed for some time in the future. Until such standards are adopted, however, and more power is given to the State authorities intelligent supervision of sewage-disinfection plants will be a very difficult and discouraging problem. If designing engineers will recognize the difficulties encountered in operation and make their plans accordingly, and if the plant attendants will appreciate their moral repsonsibility much can be done to improve the present practice in sewage disinfection.

Oxidation of Sewage Without the Aid of Filters

IN a paper (by Messrs. Arden & Lockett) dealing with experimental work in the above field, read at a meeting of the Manchester Section of the Society of Chemical Industry, the authors arrive at the following conclusions:

(1) That the resultant solid matter obtained by prolonged aeration of sewage, which has been termed activated sludge, has the property of enormously increasing the purification effected by simple aeration of sewage, or, in other words, it greatly intensifies the oxidation process.

(2) The extent of the accelerating effect depends upon the intimate manner in which the activated sludge is brought into contact with, and upon its proportion to, the sewage treated.

(3) That, in order to maintain the sludge at its highest efficiency, it is necessary that there should not be at any time an accumulation of unoxidized sewage solids.

It is not necessary that the sewage should be kept in contact with the activated sludge until such conditions obtain, as its activity may be maintained by suitable aeration of the activated sludge alone.

(4) That temperature exerts a considerable influence on the oxidation process. The purification effected is seriously diminished at temperatures constantly below 10 deg. Cent. Up to 20—24 deg. Cent. no material difference in the clarification effect and general purification has been observed, although the nitrification change proceeds more rapidly as the temperature rises. At higher temperatures the clarification effect is somewhat interfered with during the earlier period of aeration, with a consequent delay in the establishment of nitrification. Subsequently the rate of nitrification somewhat increases.

(5) That, under the conditions of experiment, a well-oxidized effluent can be obtained by the aeration of average strength Manchester sewage in contact with activated sludge for a period of from six to nine hours. The percentage purification effected as measured by the usual tests is at least equal to that obtained by the treatment of sewage on efficient bacterial filters. The period of aeration naturally depends upon the strength of the sewage treated and the degree of purification required.

(6) That the activated sludge differs very consid-

erably in character and composition from ordinary sewage sludge. It is in a well-oxidized condition, and consequently entirely innocuous, can be readily drained on straining filters, and possesses a high nitrogen content.

The scope of this inquiry has been up to the present largely confined to laboratory investigations, and while the results obtained have shown conclusively that the purification process can be readily maintained, a large amount of further research is required in order to obtain a thorough knowledge of the character and mechanism of the changes taking place, which will be essential for the efficient control of the process.

The method employed in producing a satisfactory purification of sewage is, however, of so simple a nature that there would not appear to be any insuperable difficulties in translating the experiments described on to a working scale.

In view of the obviously great reduction in the area of works required and capital expenditure involved, the available data in regard to the probable cost of aeration is such as to lend encouragement to the idea that the adoption of aeration methods on the lines of these experiments would result in a considerable reduction in the total cost of sewage purification. In this connection it may be reasonably anticipated that the enhanced value of the resultant sludge should at least cover all costs incidental to its disposal.

Tar Treatment of Macadam Roads in England

Tar painting has been carried out in Lytham for the past nine years, this town being probably the first in the North of England to adopt it. Some 300 sq. yd. of the road along the sea front, which was an ordinary macadam road, were tried experimentally, half with limestone and half with granite chippings. The portion laid with limestone was for a time almost as dusty as ordinary macadam, but the granite, being a harder material than the limestone, was practically dustless when put on, and nothing but granite has since been used for tar-painted roads. When tar painting a new road an ordinary 160-gal. tar boiler is used, which is convertible into a sprinkler with gas piping perforated to form a spray; but for repairs a small 80-gal. boiler fitted with a pump and movable spray is chiefly used. A distilled tar is used for all macadam work, and for tar painting 1 part distilled tar to 1½ of crude tar. The tar macadam is better if it can be "hogged" for some time before laying, but in winter, on grounds of economy and convenience in handling, as a rule, tar is put on the roads the same day that it is mixed. The tar-macadam used is composed of stone from 2 in. down to ½ in.

From Ottawa comes announcement by the Government that there is no truth in the published statement that capital expenditures on public works are to be forthwith curtailed, in view of the war demands on the Dominion Treasury. The Government, in view of the accentuated unemployment arising from war conditions, intends to do everything possible to continue its constructional programme, thus providing work for thousands who would otherwise be in distress. It is stated that the Dominion's loan of $25,000,000 negotiated in June, will enable the Government to keep things going until the international financial situation clears.

A New Brick-Cleaning Machine

THERE has been invented by a Philadelphia, Pa., mechanic, a machine to clean used brick that will cut the cost to half or even a third of that of the old style method of cleaning by hand. It is estimated that the number of brick cleaned in that city in a single year is not less than 25,000,000, at cost of $1 to $1.50 per 1,000. This new machine will clean them for about 50 cents a thousand. The method of operation is to put the brick into the jaws in front of the machine, which grasp it and move it sideways over the corrugated surface. This cleans the end of the brick, and at the same time the two broad sides at top and bottom are cleaned for about two inches, back of the end. The partially cleaned sides are then inserted between two projecting opposed blades of a four-sided die and a plunger at the other end of the brick comes forward and pushes the brick through. The upper plate of the die is moveable and adjusts itself automatically to the thickness of the brick. The sides, as well as the bottom and top of the brick, are thus cleaned all at the same time. The machine is four feet long and weighs 400 pounds, so that it is readily portable. It is placed upon a platform or truck so as to be about breast high. It can be operated by either one or two men, and with an engine of 2½ horse-power its capacity is 15 bricks a minute. It can be adjusted to work slow or fast as desired. The commercial value of this invention lies in the fact that when by reason of the cost or because of lack of time, old brick are not cleaned—they are thrown away as useless. With the device these brick may now be saved. In New York 100,000,000 brick are now cleaned annually by hand.

Steel Production in the United States

Statistics of steel production in the United States during 1913 are summarized in Special Statistical Bulletin No. 5, issued by the American Iron & Steel Institute. Steel production in the United States in 1913 exceeded all previous records, being 31,300,874 tons. The production was, however, only 50,000 tons greater than in the year 1912. Almost exactly half of this steel was produced in Pennsylvania. Ohio came next with 6,700,000; Indiana and Illinois combined produced nearly 5,000,000 tons. The open hearth process of steel production now far exceeds the bessemer in volume of output. Last year the bessemer steel produced amounted to 9,545,000 tons, while the open hearth steel amounted to 21,600,000. The maximum bessemer steel production was reached in 1906, when 12,275,000 tons were produced. This compares with 11,000,000 tons of open hearth steel in the same year. Since then open hearth production has been increasing at a rapid rate, while bessemer has fallen off. The production of crucible steel amounted to 121,000 tons, while 34,000 tons were made in the electric furnace. The alloy steels produced amounted to 714,000 tons. The business of steel foundings has had a large development. Over 1,000,000 tons of steel castings were produced last year, which compares with 132,000 tons af steel castings in 1898. Nearly all the open hearth steel made is now made in basic furnaces. Only 1,255,000 tons of open hearth steel were made in acid furnaces. The total number of works manufacturing steel from raw materials is 304, located in 30 different states of the Union and in the District of Columbia and Panama.

Grouping and Penetrating Methods of Road Surfaces*

By George Green, M. Inst. C.E.†

THE ideal road would be one suitable for general traffic, which could be made in a satisfactory manner at less expense than an ordinary tar-macadam road, at a quicker rate, and independently of weather conditions, and which would last longer than a tar-sprayed water-bound road. Such a road would be within the more limited means of local authorities who are not blessed with too much money to spend annually upon their roads.

While the author does not pretend that he has found the long-looked-for means of satisfying all these requirements, he desires to draw the attention of the institution to some results which indicate how partial satisfaction may be obtained; but he more particularly hopes to be able to draw from other members additional information and experience on this subject which will be of advantage to those who have the somewhat thankless duty of making roads for the public with a too limited supply of funds.

It would not be out of place, and it might be helpful in considering this subject, to note a few points which the road maker is bound to consider, and which sometimes the road users and the public at large do not thoroughly appreciate. . . . . .

Provision must be made to keep road surfaces, where the gradients are exceptionally steep, with sufficient foothold for horses, and in frosty and muddy weather when the surfaces are greasy, an adequate supply of grit must be at hand. At the same time, these surfaces should be kept waterproof and as free from mud and dust as possible on account of the ever-increasing motor traffic. If motor traffic was all of one kind, a well tarred, sprayed, macadam would meet the case in many areas and for many miles of roads; but this traffic again is divided into various classes—e.g., heavy motor, light motor, vehicles driven by steam with broad rough tires and heavy loads.

These various kinds of traffic require special and often expensive treatment to keep our roads in a satisfactory condition.

This paper does not deal with main roads or county roads, but more particularly with secondary roads in towns and suburbs, which, at the same time, have considerable traffic, and occasionally are liable to have to carry all sorts and conditions of vehicles and tractors.

From a maintenance point of view it has been found that one of the most difficult roads to keep in good condition is the level road, which, on account of its want of proper longitudinal fall, particularly in wet weather, absorbs a large amount of moisture. Even a waterproofed road is more or less liable, partly owing to its position, to retain moisture in its foundations or in the subsoil if the district around is of a low-lying insufficiently drained character.

A road that has a good gradient is generally self-cleansing with every shower of rain, and has a chance of a much longer life, in addition to being more easily kept clean and in a satisfactory condition. The margins of roads where tram lines are in the centre will not be dealt with. These have caused enough anxiety, and will continue to do so, to their surveyors as long as tram lines exist, and must always require more or less special treatment. Another reason for calling particular attention to the grouting and penetrating methods is the great difficulty, which it is believed is not uncommon, experienced in obtaining the necessary supplies of tarred road materials of various kinds in the quantity and at the times when they are most urgently needed.

One frequently has the misfortune to have a long and important road undergoing reconstruction, and to be hampered and harassed with the difficulty of obtaining a sufficient quantity of these materials to continue and complete the work in anything like a reasonable time.

All these difficulties make it desirable and necessary for road makers to have more than one string to their bows, and to be able to turn to fresh sources of supply and to use various materials and methods, when emergencies of this nature occur, in order to complete their road making and repairs in a reasonable time with as little inconvenience to the public as possible.

Two points that road engineers have to deal with must be emphasized: Road surfaces must not only be able to stand the suction which is the result of rapid motor traffic, with india rubber tires, which removes the dust, grit, sand, mud and water out of the water-bound roads, and sooner or later the small and then the larger stones themselves as they become loosened by disintegration, but consideration must be given to the provision of surfaces which will withstand the vibration from heavy vehicles—horse drawn, steam driven, and otherwise—which, with the continual hammering of the horses' hoofs and the solid iron tires, often shake the crust of the road and also its foundations.

It is obvious that a tar-sprayed road cannot last long under all these conditions. If the traffic were uniform, the problem would be simpler, and less expensive methods might be more easily adopted. All these points have to be considered in the construction or reconstruction of any road, and, as a rule, a road crust has to be constructed on such foundations as will be able to withstand all these conditions in a thoroughly satisfactory manner.

So far, difficulties common to all road engineers have been dealt with, among which that of an adequate supply of materials is by no means the least at the present time.

It no doubt arises largely from the fact that tarred materials of one sort or another have been recognized as one of the chief and best methods of road making, and road authorities—county, urban and rural—are all, without exception, making great efforts to meet the road problem of the day, and partly also on account of the fact that tarred materials can best be laid in dry weather, as most of these new surfaces and reconstruction of roads are done in the few months in the summer which can be relied upon as most suitable for this purpose.

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* Paper read at the annual meeting of the Institution of Municipal and County Engineers [Gt. Britain.]

† Borough Engineer, Wolverhampton, Eng.

If anyone can discover a material which can be used as satisfactorily in wet weather as in fine, or in winter as easily as in summer, no difficulty would be found in obtaining a ready sale for it.

It seems almost superfluous to reiterate here the great advantage of tar-spraying on well-constructed macadam roads. Most engineers have found that this is of immense advantage not only in the prevention of dust and mud in main roads subject to heavy and rapid traffic, but also that it adds considerably to the life of those roads, and is a distinct advantage from a health point of view in second-rate residential roads made of macadam in which many of the poor in our towns have to live. These streets often swarm with children who use them as their chief playgrounds. The sanitary advantage of tar-spraying in these roads can hardly be over-estimated.

Leaving the difficulties of the situation generally, stress must be laid on the great importance of having proper foundations and good drainage to all roads which are to be treated with waterproof surfaces and have to bear heavy traffic. Many roads which have for years been subject to heavy traffic have been found to consist almost entirely of a number of coats of macadam laid one upon the top of the other, the whole mass resting on a clay underbed without foundation or drainage of any kind. It is impossible for roads constructed on such lines to last, and in such cases the old macadam has invariably had to be removed, and below that, to the required depth, the surplus soil excavated and removed, and in its place a foundation of 6-in. or 8-in. slag pitchers laid upon a properly formed and well-rolled bed consisting of several inches of rough, hard clinker. The advantage of this layer of clinkers is to prevent the clay or underbed working through the pitchers towards the surface, and consequently causing the foundation to give way and become uneven. This usually forms an excellent drainage, and remains of lasting benefit to the newly constructed road. Upon this foundation several types of grouting or penetrating methods have been tried, the first which naturally suggested itself being that of ordinary tar. The first trial of this kind was made some five or six years ago on a road which had a natural and sufficient gradient longitudinally. There were tram lines in the centre, the whole surface on either side of the tram lines was scarified and regulated, and after that coated one stone thick with cold blast-furnace slag, carefully and sufficiently rolled in dry. After this a mixture of 40 gallons of gas-tar (not distilled), 6 cwts. of pitch and 4½ gallons of creosote oil, as the constituent parts of the grout, was poured on the surface through cans and rubbed in with squeegees; the surface was then coated with a thin layer of slag chippings and gently rolled in with a 10-ton roller, after which a second and thinner coat of the tar mixture was spread over the surface and another layer of finer grit to spread upon the top. This road surface, which is subject to a fair amount of traffic of various kinds, has lasted up to the present time with hardly any repairs except for trenches and occasional small repairs.

This class of road, provided it is constructed in dry, suitable weather, answers a very useful purpose, and, of course, is more lasting than tar-spraying and very little more costly than ordinary water-bound macadam, provided the same road material is used. Of course, a road of this kind could only be made in suitable weather, and should a period of wet weather follow the commencement of the work, completion might be delayed for a considerable time.

Experiments have been made on a similar form of road, with Plascom as binding material, with varying success; in some places the earlier work has stood for a number of years, and has a very satisfactory surface, in others there have been less satisfactory results owing to the heavier nature of traffic and to a level surface. A year ago a more elaborate experiment was made with this material. The road in this case was laid in two coats; the first coat was treated similarly to the one made of slag referred to above, and after it had been thoroughly grouted and rolled in, a second coat, one stone thick, of basalt was laid upon the top, and the process repeated with Plascom and chippings until the final surface was finished.

This was only done a year ago, and the length of its life cannot be estimated. The carriageway is narrow, the surface is a level one, with hardly any gradient, and the traffic of a heavy nature, mostly with iron tires, such as railway drays and vehicles of that kind. The surface today is almost as good as when it was laid down, but time alone can say how long it will last. Ordinary water-bound macadam in this road only lasts a year.

Roads grouted with Rocmac and with Glutrin have also been laid in an experimental manner, also with various results, but the latter experiments, made about twelve months ago, when the materials in both cases were mixed on boards in the form of concrete, have been much more satisfactory, and promise to make a more lasting surface, and one which affords at the same time a most excellent foothold for horses. The great advantage of these two materials is that they may be laid in wet weather even better than in fine weather, and consequently the work is not interrupted for any outside cause, as is the case with tar roads sometimes.

Plascom, Rocmac and Glutrin are more costly than Tarmac in the first instance, but the length of life has so far not been sufficient for a proper comparison.

Beyond the fact that Rocmac and Glutrin grouted roads can be constructed in winter, they afford a much better foothold for horses. A coat of tar dressing in the summer will prevent them being dusty, and add to the length of life generally.

A road was formed and treated with Bituvia on similar lines to Plascom and tar grout, and this, although only a year old, is also in good condition, and promises a fair life in the future.

There may be other forms of grouted roads equally good and useful, but there is still room for further progress in this direction, and the inventor, if the method be not an expensive one, might easily make a fortune. Most engineers would be glad to have a longer period, extending through the winter, in which to continue their road work, especially as sometimes it is difficult to find sufficient employment for all their good and useful men during the winter months when work is most needed.

A method of constructing a "noise-proof wall" consists of applying a coat of cement against a background of tar paper. It is stated that no loud tone of voice, pistol shot, or high note can penetrate the thickness of cement and paper.

Fraser River Development

The preliminary work of acquiring necessary data in connection with the preparation of plans for the future development of the North Arm of the Fraser River is progressing satisfactorily, and Messrs. Davis & Leslie, of Vancouver, consulting engineers for the undertaking, report that the results of the work done so far have been very encouraging. The jurisdiction of the North Fraser Harbor Commissioners covers the whole of the North Arm from the western boundary of New Westminster to Point Grey, a distance of about 17 miles, and includes the adjacent waters of the Gulf of Georgia over what is known as Sturgeon Bank. The test borings between Point Grey and the boundary of New Westminster (41 in number) have now all been completed, and with the exception of a couple of holes where a ledge of hard pan appeared at a depth of about 25 feet, the material throughout was proved to be of a nature well adapted for economical removal by suction dredging. It was anticipated that this would be the case, but definite confirmation was essential on a point so materially affecting the cost of the scheme, and this has now been obtained by carefully supervised tests.

Surveys of the shore and islands have been made, also observations of the river currents with soundings to correspond, while a complete series of soundings covering the whole work are now in progress, two parties being employed in this work. The results so far go to show that the North Arm has fully maintained its depth, and in some stretches is deeper than it was a few years ago.

Waterproof, Cleanable Whitewash

One pound of glue is dissolved in 3½ pints of water. To this is subsequently added three ounces of bichromate of potash dissolved in half a pint of hot water. These two ingredients are thoroughly mixed, and enough whiting then added to secure the right consistency. The mixture is applied to walls or roofs in the usual manner, and dries rapidly, while the action of the sun upon the potash and glue serves to render it waterproof.

Such a whitewash is available for a variety of applications both exterior and interior. It adheres firmly to slate, glass, metal, masonry, or plaster, care being taken, if on plaster, to rub it well in with the brush. It not only affords an excellent protection from the effects of the sun's rays in hot weather, but acts as an admirable waterproofing to walls exposed to driving rains. When desired, it can be cleansed with a hose and cold water, or washed with a sponge.

Hand Concrete Mixer Employed Successfully

A hand concrete mixer was used in the construction of the new combined concrete and timber snowsheds of the Great Northern Railway. While ½-yd. power mixers were used for the heavy work of the retaining walls or back walls, the hand mixer was used extensively in making the concrete for the pedestals which support the timber posts for the roof. This arrangement worked out very conveniently, as the pedestals usually could not be built when the backwall was being built, while the amount of concrete in each was so small and the work so scattered that the concreting could be done in this way more economically than with a power mixer. This machine had a 36-in. drum of about 2½ cu. ft. capacity, 32 ins. long, on each end of which was an internal gear meshing with a pinion driven by a crank handle. The charging and dumping were done through openings extending across the drum, and the concrete was dumped directly into the forms, the machine being carried by a pair of 30-in. wheels so that it was easily shifted from place to place.

Municipal engineers are brought more closely into touch with the struggle in which the empire is taking such a vital part by the precautionary measures that are being taken. Special guards have been posted at Montreal's two reservoirs, as well as at the conduit and pumping plants. Following the example of the Dominion Government in placing a guard on the Welland Canal the city of Toronto is guarding its waterworks system, which is the most vital of its public service. It will no longer be possible to obtain access to any part of the system without a special permit from the department, and extra watchmen will be kept on duty at all hours. Recommendations in favor of placing the Hamilton water-works under guard have also been made.

Leaks in a concrete pressure conduit 1,885 ft. in length and 7 ft. in diameter, which led from the basins to the pumping station at the Bissels Point water intake in St. Louis, were comparatively few, according to the annual report of the water commissioner, despite the fact that work was carried on at temperatures ranging from 70 to 20 deg. Fahr., and that the conduit was exposed during the most severe weather. No temperature cracks were apparent and the comparatively few leaks that did show up were near the top at the end of a day's work and where a dry mix was used. The leaks were easily repaired and the conduit was made watertight before backfilling began. All concrete was of gravel with cement and sand in such proportions that one sack of cement produced 4½ cu. ft. of concrete. Twelve pounds of hydrated lime were added to each sack of cement and the mixture was retained in a batch mixer for 3 minutes.

Bulkheads for tunnel forms are always difficult to build because of the roughness of the rock profile. The Pneumatic Concrete Placing Company, of New York City, which is specializing in tunnel-laying work, has been experimenting to find a suitable way of building such bulkheads quickly and cheaply, and has found that cement sacks three-quarters full of sand can be used successfully. The sacks are laid on top of each other in the same way as bricks in a wall, and can be fitted into all crevices of the rock, following closely the irregularities of the profile. It is stated that one unskilled laborer placing sacks replaces two carpenters building forms. A bulkhead formed in this way is said to be tight, and is left in place the same length of time as a wooden one. When the sacks are removed the concrete surface is rough and gives a good bond with the adjacent section.

In scrubbing concrete surfaces, care must always be taken to avoid roughening or blunting corners of the work, and to maintain all edges sharp.

LETTERS

The Deposit Cheque

London, Eng., August 1, 1914.

Editor Contract Record:

The deposit cheque is such an unfair institution that, to an English reader, the query in the July 15 issue of the "Contract Record" scarcely seems to need a reply. To ask a man to deposit from five to ten per cent. of the amount of his tender, on the off-chance of obtaining work, is really a most barefaced proceeding. "The department does not bind itself to accept the lowest or any tender." It does not even bind itself to enter into a contract with anyone, and if a contract is entered into eventually there is no reliance upon when the procedure will be carried through. If, however, "the persons tendering decline to enter into a contract when called upon to do so"—when called upon to do so, ye gods!—"the deposit will be forfeited."

Put into plain English the matter stands thus: Jones thinks of having some work done. He is not certain whether he will have it done or not, and if he is going to have it done he can't say when. So he calls a score of men around him and he explains the circumstances. "You see I can give no promise at all," he says; "but if you care to weigh out a heavy cheque each and accompany it with the price you think the work could be done for I'll register your name and hold your deposit. I'll accept one of your prices some day and then I'll return all the other deposits, but the deposit of the lucky man I'll stick to, and woe betide him if he gives me cause for complaint. If he does I'll fire him off the job, finish it myself and hold his deposit for ever. Of course, it will be just the same if I never have the work carried out, for until he has carried it out he can't claim the return of his cheque. I? Oh no, I guarantee nothing, absolutely nothing at all. You must think yourself honored to be allowed to have a chance to work for me and to pay handsomely for the privilege."

Now, is that a business proposition? Would any man other than a contractor enter into it, or even be expected to enter into it? Let the engineer try it on himself. Let him prepare plans and specifications for nothing, in competition with a score of others, and let him be forced in addition to deposit a substantial cheque as a guarantee that he will, if and when called upon, supervise the works to the satisfaction of the employer. There is no more reason why the contractor should work for nothing than the engineer, or why the employer should pay the engineer for all he does and the competing contractors nothing, except in the case of the successful man, And to add indignity to injury, when a contractor makes (or at least pleads that he has made) a mistake in the preparation of his tender and asks for the return of his deposit, he lays himself open to suspicion of collusion.

But surely collusion is the last charge that could reasonably be brought in such circumstances. If there had been a ring of contractors, no such error as pleaded could have crept in, and for the ring to have arranged for one of the conspirators to put in a ridiculously low tender and risk the loss of his deposit is beyond the question. If the profit was to be "cut up" among the members of the ring, the tenders would be unreasonably high and not ridiculously low. It cannot be argued logically that to favor the return of the deposit of a man who pleads an error and who has submitted a price at which the work cannot be done is a "vicious principle" or that it "encourages collusion among contractors." A solution to the whole trouble would have been the acceptance of the lowest tender but one.

Yours truly,

"An English Reader."

Toronto's New City Architect

Mr. W. W. Pearse, who was recently appointed City Architect of Toronto, is now presiding over the architectural destinies of his native city. Born in Toronto forty-two years ago, he received the rudiments of his education at the public school, passing subsequently to the Jarvis Street Collegiate. He took a five-year course in connection with the Ontario Association of Architects, on the completion of which, at the age of twenty-two, he went to New York. He obtained the degree of Bachelor of Science, after a five-year course at Cooper Union, and also the post-graduate degree of Civil Engineer. Continuing his studies, he took a special three-year course in German methods of engineering. He was elected an Associate Member of the American Society of Civil Engineers, and also a Member of the American Association of Architects. Mr. Pearse is not identified with any other societies.

The practical experience which Mr. Pearse has had in the architectural and engineering fields is very wide, embracing some of the best work carried out in the United States within recent years. While resident in New York he spent all his time studying the engineering side of architecture. Amongst the more important buildings the structural work of which was carried out under his supervision, mention may be made of the armoury for the 71st Regiment, which consists of trusses of 190-ft. span; an armoury for the 2nd Battery, with trusses of 160 ft. span; the Traders and Importers Building of eighteen storeys; five theatres, of which two of the largest are the Broadway Theatre, Brooklyn, N.Y., and the Harlem Auditorium, New York. During his career in the United States he has been the engineer for some of the most prominent architects of New York, including Messrs. Rouse & Goldstone, Messrs. Foster & Gady, Mr. Wm. B. Tubby, Mr. Elliott Lynch, and Messrs. Summerfelt & Steckler. In connection with the last-named firm of architects Mr. Pearse has carried on the engineering work associated with a number of the twelve, sixteen and twenty-storey buildings erected by them in New York.

City Architect Pearse, of Toronto.

Mr. Pearse has been a valued contributor to prominent engineering journals. One article from his pen deals with the complex problem of lattice bars and columns, and another with the buckling of webs and beams.

The Municipal Convention at Sherbrooke

OWING to the European situation and the desire of the Delegates to return home, the Convention of the Union of Canadian Municipalities at Sherbrooke, P.Q., was curtailed. The Convention was to have been held from August 5-7, but on the 6th the delegates decided to close the proceedings.

The opening day was occupied largely with an opening address by Sir Francis Langelier, Lieutenant-Governor of Quebec, in which he deprecated the mixing of politics with municipal affairs. Business men, he suggested, should take a more active interest in local matters. Mayor Mackinnon followed with a speech of welcome, and Mayor Bligh, of Halifax, gave the presidential address. Mr. W. D. Lighthall, K.C., reviewed the activities of the Union during the year.

A resolution was passed asking the Federal Government to give financial assistance in constructing a trunk road across the continent, thus connecting the east and west.

It was proposed by Alderman L. A. Lapointe, Montreal, and Mayor Graham, London, seconded by Controller T. L. Church, Toronto, and Alderman Leslie Boyd, K.C., Montreal: That this convention of the Union of Canadian Municipalities, now being held in the city of Sherbrooke, as representing municipalities throughout the Dominion in entire sympathy with the Mother Country in the position she has taken in this critical moment, places itself on record that any steps taken by our Government to help in protecting the integrity of our Empire will have the fullest support of the united people of Canada." This was carried by a standing vote.

Mr. F. W. W. Doane, City Engineer of Halifax, read a paper on "New Municipal Engineering Matters," while the following other papers were taken as read: "Highway Progress in Quebec," Mayor Hayes, of Richmond, Que.; "Western Municipal Progress," Mr. J. N. Bayne, of Regina, Sask., Deputy Minister of Municipal Affairs, Saskatchewan; "The City Manager," Mayor Graham, of London, Ont.; "Problems of Prevention in a Modern Municipality," Mayor Hocken, of Toronto, Ont.; "Municipal Taxation," Mr. P. W. McLagan, Chairman of Finance, Westmount, Que.; "Assessment and Taxation," Mayor Oliver, of Port Arthur, Ont.; "Taxation of Improvements," Mr. A. B. McNeill, Alderman of Victoria, B.C.; "Hydro-Electric Power," Mr. B. A. Dugal, Accountant, Electric Dept., Sherbrooke, Que.; "Taxation and Finance in Rural Municipalities," Mr. John Perrie, of Edmonton, Deputy Minister of Municipal Affairs, Alberta; "Housing of the Foreign Population," Mayor Young, of Fort William, Ont.

It was decided to hold the next Convention in Victoria, B.C.

The following resolution was adopted on the motion of Mr. W. D. Lightall: "That in view of the present war situation, although the situation of Canada is most favorable, the municipalities of Canada are recommended to exercise great care and prudence in their undertakings and financing, and especially to consult closely with the local bank authorities on the various aspects of the situation, and to co-operate with them and the Dominion and Provincial Governments for the best course of action.

The election of officers resulted as follows: President, C. M. R. Graham, Mayor of London; 1st vice-president, Controller T. L. Church, Toronto; 2nd vice-president, Ald. L. H. Boyd, Montreal; 3rd vice-president, Ald. Costello, M.D., Calgary; honorary secretary-treasurer, W. D. Lightall, K.C., ex-Mayor of Westmount; assistant secretary, G. S. Wilson, Montreal.

Mainly Constructional

East and West—From Coast to Coast

EASTERN CANADA

Rumors to the effect that the Works Department of Toronto is curtailing its constructional programme are without foundation. All the city's jobs are proceeding as scheduled.

The name of Mr. F. C. Askwith, Assistant City Engineer of Ottawa, has been suggested in connection with the vacancy caused by the retirement of the City Engineer, Mr. Currie.

Messrs. Quinlan & Robertson, Limited, Montreal, have obtained a contract running into $185,000 for paving work on Church Avenue, Wellington Street and LaSalle Road, Montreal.

Mr. John B. McRae, consulting engineer, of Ottawa, will be engaged to co-operate with Mr. R. L. Haycock, Acting Waterworks Engineer, in preparing estimates of the cost of a number of changes suggested in regard to the report on the city's water supply.

The resignation of Mr. Archibald Currie, City Engineer of Ottawa, has been followed by that of the Water-Works Engineer, Mr. A. N. Beer. In the case of Mr. Currie the Board of Control has recommended that he be given three months' salary. Mr. Beer will probably receive two months' salary.

Messrs. Hering & Fuller, of New York, report that ninety-five per cent. of the length of the Montreal water conduit is in satisfactory condition and that the remainder can be repaired readily. The inspection of the thirty thousand feet of conduit was made by Dr. Hering in company with Chief Engineer Janin and others.

Representatives of a prominent American firm of gas and gasoline engine manufacturers were recent visitors to Fort William looking over the situation with a view to establishing a factory. A member of the party stated that it was quite probable that a distributing house would be constructed prior to the erection of a factory.

At Victoria, B.C., a number of the members of the Canadian Society of Civil Engineers met last week at the office of Mr. A. W. Wilby, District Engineer, Department of Marine & Fisheries, and unanimously decided to offer their services to the authorities. A telegram was despatched forthwith to the Minister of Militia. Major Hodgins presided.

Over one thousand residences of moderate size are being constructed in the district within the city of Toronto and east of the Don, and over five thousand men are employed. For the most part they are being constructed for individual owners of lots in the midst of large areas of unoccupied land extending on either side of Gerrard street and north of the Danforth district.

According to a Quebec despatch, H. S. Mundheim, General Manager for the Cement Produce Company of Canada, with factories on the Island of Orleans, on which is established the naval station for the inspection of ships, is held at the citadel as a prisoner of war. Rumors to the effect that he was held as a spy are current, but no authoritative statement is available from the authorities.

The Fort William plant of the Canada Iron Corporation is working to capacity. Orders have been coming in so rapidly of late that it has been necessary to transfer a portion of the work that should be done in Fort William to some of the Eastern plants. This augurs well for the future. The local demand for cast iron pipe, together with orders received from Western Canada cities, has had the effect of keeping the plant running steadily since the first of the year.

Messrs. M. C. J. Bellingham, W. A. Newton and W. D. Cook have formed a partnership under the name of Bellingham, Newton & Cook, engineers and architects, with offices at 213-14 Confederation Life Building, Toronto. These gentlemen have all been on the staff of Mr. D. J. Albertson, of Kalamazoo, Mich., engineering specialist on pulp and paper mills. For the last two years Mr. Newton has been in charge of Mr. Albertson's Toronto office, which was closed recently.

The inquest on the death of Robert Strathern, the Toronto engineer who was asphyxiated while measuring in a sewer, was brought to a close last week. The jury decided that death was due to poisoning by illuminating gas, and were of the opinion that the city of Toronto showed neglect by not instructing all contractors to properly support all underground pipes from the bottom up in such excavations, and also for not engaging qualified resident engineers for sewer work.

At Hamilton last month, the value of building permits taken out amounted to $248,000, while in July, 1913, the amount was but $233,000, the increase this year being $51,900. From all accounts the prospects are exceptionally bright for August, and until the end of the year there should be a good rush. The inspector has been approached by a number of people who intend building this month, which will mean that many permits will be issued and that a good deal of work will be provided for the building trades.

From Fort William comes word that the extension to the sea-wall at the mouth of the Mission river has been completed so far as it is intended to be done this year. The extension to the concrete docks of the Grand Trunk Pacific Elevator is being pushed forward rapidly and will be completed shortly. Good progress is being made by the clam shell dredges at work on the big turning basin now in course of construction about five and one-half miles up the Kaministiquia river. Dredging operations this year have been carried on almost without interruption. The value of harbor improvements this year will total nearly $2,000,000.

The Maritime Dredging and Construction Company, St. John, N.B., have been awarded a contract for additional improvements at St. John harbor. They will build temporary sheds 505 feet in length, 80 ft. in breadth, and 15 ft. high. These sheds will be large enough to handle any additional traffic which is likely to come to St. John next winter. The contract calls for their completion by December 15 next. The Maritime Dredging Company is making good progress with the concrete superstructure on the Connelly wharf, and D. C. Clarke, who is doing the crib work, has nearly completed his contract. In the work of filling in the quay walls the Maritime Dredging Company are laying about 250 yds. of concrete a day.

The city of Hamilton, Ont., will expend $200,000 for concrete sewers and other improvements. The sewers will vary in size from 6 ft. 8 ins. to 30 ins. The larger will probably be laid in tunnel section about 2,000 ft. in length and 24 ft. below the ground surface. The remainder of the sewers will be laid in open trenches. The original plan for sewerage improvements called for an expenditure of $400,000, part of which was to be for the sewage disposal plant. The latter part of the undertaking, however, was abandoned for the time being. It will, however, have to be dealt with within a comparatively short time. It was proposed to reconstruct the present septic tanks in the disposal plant into Imhoff tanks and also to add four more Imhoff tanks to take care of the future flow. The plans were drawn to carry the wells of the old septic tanks down to a depth of 20 ft. so as to allow the concrete aprons to give sufficient sludge capacity beneath. The $200,000 appropriation will furnish funds for a new pumping station with pumps and motors, each pump having a capacity of 7,500,000 imp. gals. per 24 hours. The sewage will be carried through the largest sewer mentioned above to the wells, where the invert of the sewer will be 13 ft. below the level of the water of the lake. From this well the sewage will be pumped to the 30-in. cast iron main to the old disposal works which at present are being used as sedimentation tanks. Mr. A. F. Macallum is City Engineer of Hamilton.

WESTERN CANADA

The Calgary University contract has been awarded to Messrs. Archibald & Company, Winnipeg. The estimated cost of the building is $100,000.

Plans have been approved for the construction of a Roman Catholic Church on the south side of Broadway, Winnipeg, at an approximate cost of $500,000.

A sewage and water system is to be constructed at St. James, by the Rural Municipality of Assiniboia, B.C. The Municipal Engineer has charge of the work, which is estimated to cost about $500,000.

The new gaol and courthouse, which is being erected at Regina at a cost of $100,000, is nearing completion. The general contractors are the Parsons Construction & Engineering Company, Limited.

Plans for a bridge at Banff, Alta., estimated to cost $200,000, have been approved by the Department of Public Works. Operations will be commenced this fall. The bridge will be of concrete construction.

The construction of 85 miles of concrete aqueduct in five sections of approximately equal length, has been decided upon by the Commissioners of Greater Winnipeg Water District. . Tenders have been called for September 19.

Plans have been prepared by Mr. Thomas Hooper, Vancouver, for the construction of a reinforced concrete wharf, subway and factory building for the Royal Crown Soaps, Limited, of Vancouver, to be erected on Burrard Inlet.

Plans are in hand for the construction of a $700,000 hotel on Main street and James avenue. The building will be ten storeys, of steel, brick and terra cotta construction. The H. L. Stevens Company, Ill., are the architects and general contractors.

The Trades and Labor Council, Calgary, are protesting against the award of the local university building contract to a Winnipeg firm. The local press states that labor men in the city are generally indignant at the action of the council in bringing in an outside firm.

Work is proceeding on the construction of the new drill hall which is being erected in the northwestern section of Winnipeg at a cost of $110,000. The building will be of brick and stone construction, with steel framework. The Brown Construction Company, Limited, are the contractors.

Work on the hydro-electric plant for the city of Kamloops, B.C., under way for a couple of years past, is now nearing completion. Messrs. DuCane, Dutcher & Company, engineers, Vancouver, announce that the turbines, generators and other equipment will be installed in the near future.

The Canadian Northern Railway has just placed an order with Canadian firms for more than $1,500,000 worth of equipment, sufficient to put on the most modern service between Toronto and Winnipeg, by way of their new line from Port Arthur to Sudbury. It is probable that through trains will run from Edmonton to Toronto as soon as this equipment is delivered. The successful tenderers are the Canadian Car & Foundry Company, the Hamilton National Steel Car Company, the Crossen Car Company and the Preston Car & Coach Company.

Operations have commenced on the erection of an apartment block at the corner of Sargent and Beverley Streets, Winnipeg, which is to be erected by Messrs. Genser Brothers. The building will be three storeys high, of steel and pressed brick construction. The estimated cost is $150,000.

Messrs. Hodgson, King & McPhalen Bros., have been awarded the construction of the proposed extension to the China Creek sewers. The work comprises the following: 2,600 ft. of 6 ft. 6 in. tunnel sewers; 800 ft. of 4 ft. 3 in. tunnel sewers; 21,000 ft. of concrete sewers in trench and 1,500 ft. of vitrified pipe sewer in trench. The contract price was $309,053.

The enterprising city of Vernon, B.C., is about to expend $100,000 on a modern sewerage system. A new disposal plant will prevent the contamination of Kalamalka Creek and Okanagan Lake, and an under-drainage system will be installed to carry off surface water, which now runs into the pipes of the present system and makes the flow excessive.

Mr. C. H. Rust, City Engineer of Victoria, was in Vancouver recently conferring with Mr. G. R. G. Conway, Chief Engineer of the British Columbia Electric Railway Company, respecting the Johnson Street bridge at Victoria. The railway company wish to have the plans of the structure altered to meet the requirements of their heavy electric locomotives. The additional cost will not exceed $50,000.

At Edmonton, Alta., the excavation for the new Central Police station, which is to be erected at a cost of $325,000, has been completed. It is not likely that the erection of the building will be undertaken this season. The structure is planned to be four storeys high, 190 by 60 ft. in dimensions, of stone construction. The architect is Mr. A. Jeffers, and the general contractors are the City Construction Department.

Work is in progress on the G. T. P. Railway hotel to be erected at Regina, Sask., at a cost of $1,000,000. The steel will be supplied by the Canadian Bridge Company, Limited, Walkerville, Ont., and the terra cotta by the Atlantic Terra Cotta Company, Limited, New York. The building will be nine storeys, 160 x 160 ft., steel and stone construction. Messrs. Lyall, Mitchell & Company, Regina, are the general contractors.

A new Association of Architects of Manitoba was formed recently, and a council of nine members was appointed for one, two and three year periods. Mr. H. E. Mitchell was elected president, Colonel Mitchell, vice-president, and Mr. R. G. Hanford, secretary. The old association has been incorporated with the Manitoba Board of Examiners of Architects under an act passed by the provincial legislature last session.

It is encouraging to note that Messrs. Tramways, Limited, the firm which proposes to build the inter-urban line in the Edmonton district, is prepared to proceed with the project as soon as arrangements can be finally completed by the City Council. It was feared that the money for the undertaking would not be forthcoming, but this idea has been dispelled by definite assurance from New York City. It is expected that the firm will employ about three hundred men and eighty teams at the outset.

While the $300,000 mark was not reached at Regina last month, the building permits for July make a good showing when compared with the corresponding month last year. The total for the month was $258,780, as compared with $215,925 for July last year. The principal feature of the July permits was the large proportion issued for the construction of residences, nearly all the permits being in respect of private houses.

At Calgary, the Waterworks Engineer, Mr. A. W. Ellson Fawkes, has submitted to the Commissioners a detailed statement concerning the proposed gravity water supply from Elbow River. The total estimated cost of the undertaking is $2,000,000. The largest contributing items of expense are the construction of a masonry dam at a cost of $537,000; 32 miles of 36-in. wood stave pipe at a cost of $680,000, and earth-work at a cost of $554,000. The Commissioners have decided not to submit a by-law to the ratepayers this year, although they have practically adopted the scheme.

On the north shore of Burrard Inlet, opposite Port Moody, the Imperial Oil Company is erecting an immense plant upon which over 350 men are employed. The buildings comprise a brick power house, machine shops, storage sheds, etc., and the plans provide for thirty-five large tanks for the storage of oil. Two of these reservoirs will be 115 feet in diameter, and 35 feet in height; three will be 93 feet in diameter, and the same height; six will be 50 feet in diameter, and the rest will be of smaller dimensions. Kerosene, naptha, lubricating oil and gasoline will be refined or distilled, as the case may be. In order to accommodate the tank steamers which will bring oil from California, the company will build a dock 750 feet long, out to deep water, with slips for smaller craft. Powerful pumps will transfer the oil from the vessels to the tanks and storage reservoirs.

The Provincial Government of British Columbia is erecting two new pumping stations on the dyked lands adjoining the Pitt River. One of these stations is to be located on the Maple Ridge side and the other on the lower Coquitlam side of the river. These new plants have been necessitated by the growing utilization of these dyke lands. In the last two years a number of industries have been located on the Coquitlam side, and these required considerable land drainage pumping during the summer freshet season. The water in the ditches inside the dykes will now be maintained at a much lower level than heretofore. This will be accomplished by the large centrifugal pumps which are onw being installed. These pumps have been ordered by the government from the W. Poole Dryer Company, Limited, Engineers, of Vancouver and Glasgow, Scotland. This firm has in the last two years constructed a number of electric pumping plants on the Fraser and Pitt rivers. For the present work they are being manufactured in England. The amount of water pumped by each of these sets would be 30,000 gallons per minute, this quantity requiring a discharge pipe of 36 inches diameter. The pumps, which are to be belt-driven by electric motors, were selected by the engineers largely on account of their high efficiency.

"The Hy-tex House of Moderate Cost," published by the Hydraulic-Press Brick Company, St. Louis, Mo., is an attractive book which contains a selection of nearly one hundred designs submitted in connection with a competition conducted last spring by the Brickbuilder at the instance of the above firm. The plans were prepared by architects who were given a definite problem of a detached house faced with Hy-tex brick to be built at a cost not exceeding $7,000. It was assumed that the house was to be located in a town, small city, or suburb of a large city, on a level lot of any size or shape. Nearly four hundred designs were submitted by prominent architects throughout the country, so that no special commendation of the drawings reproduced in the book is required. Suffice it to say that the various sketches offer many interesting ideas and that the book should be well received by architects and prospective builders.

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Alphabetical Index of Advertisers
Page 18

Vol. 28 **August 26, 1914** **No. 34**

Principal Contents

Page
Optimism Still Possible 1065
The European War in Its Relation to Canadian Trade 1066-7
Reinforced Concrete Log Chute and Dam at High Falls, Que. 1068-9
Bonding Asphalt to Concrete 1069
Efficiency and Economy in the Design of Factory Buildings 1070-4
By W. E. King
Water Sterilization by Ultra-Violet Rays 1074-5
Cleaning Stone Work 1075
The Organization and Management of the Stores Department 1076-81
By W. G. Astle
Painting on Cement or Concrete Surfaces 1081
Deep Water Concreting Through a Tube 1082-4
By E. B. Van de Greyn
Dilution and Sewage Treatment 1084
Limitations of Commercial Engineering 1085
Examination of Concrete Failures for Their Determining Causes 1086
Architectural Terra Cotta 1087
The Selection of Asphaltic Material for Road Construction 1088
Notes on Causes of Failure of Stucco Work 1090
Constructional News 1091-2

Optimism Still Possible — Convincing Evidence of Building Returns

To those of our pessimistic friends in the constructional world who are casting about for a stray straw to keep them from being utterly submerged in the dark, chilling depths of pessimism, we would point the record of building permits for the seven months of 1914 ending July 31. In a comparison with the 1913 returns we find that thirty-nine cities of the Dominion rolled up a total of rather more than eighty-five million dollars last year in the seven months period, as against $71,000,000 this year. This means a decline of 16½ per cent.—surely a very satisfactory showing, all things considered.

Going into detail, we find that twenty-four Eastern cities expended, roughly, $44,000,000 from January 1 to July 31, 1914, as compared with rather more than $46,000,000 for the corresponding period of the previous year; while fifteen Western cities spent $27,000,000 this year as against $39,000,000 last year.

It will be seen that in spite of the great activity which prevailed last year throughout the Dominion, Eastern Canada at any rate practically held its own until the end of July, and even in the West the falling-off was not nearly so great as many would have us believe. It is noteworthy that the 1914 returns from Montreal and Toronto are neck-and-neck with last year's figures. In the seven months period of both years the Montreal total was in excess of eleven million dollars and the 1913 figures were less than $500,000 greater than those of 1914. The Toronto returns of nearly sixteen millions in 1914 as compared with seventeen and one-half millions last year are also very satisfactory. And Montreal and Toronto are not isolated examples. Other Eastern cities to record gains in the seven months period this year were Sydney, N.S., Maisonneuve, Quebec, Berlin, Guelph, London, Peterborough, Port Arthur, St. Thomas and Windsor.

In the West, the most conspicuous example of progress in the face of depression is Winnipeg, whose total of nearly thirteen millions in the seven months period of 1914 was nearly two million dollars ahead of last year.

The reader may object that we are talking of things that happened before the war broke out. Possibly he may challenge us, forthwith, to find some ground for optimism out of the present situation, leaving the records of the past to take care of themselves. In that event we take up the gauntlet and throw it down on the next page. There are grounds for optimism whichever way we turn. There is encouragement in the past, present and future. Canada's constructional achievements of the past should lead us to be optimistic in the present and imbue us with confidence in the future.

Pessimists, like the poor, we shall always have with us. So far, however—thank God—their dire prophecies have come short of fulfilment.

The British Nation

The nation is calm, collected, and determined. Mobilization is progressing swiftly and smoothly. Our transport both by rail and road is working splendidly. It remains now to keep calm, to trust in our authorities, Naval, Military, and Civil, and each on our own part to add the great or little help as it may be in our power to give to those around us.—The Engineer (London, Eng.).

The European War in Its Relation to Canadian Trade

A Time When Courage and Confidence Await the Dawn of Greater Opportunity—Every Incentive to Maintain the Country's Business Stability and Prepare the Way for Expansion—Exports and Imports

NOW that everyone has had the opportunity to express an opinion as to the probable duration of the war, the cost of it in men and money, its effect upon trade, and a dozen minor phases, there would appear to be some justification in taking a little time to sift the material—to separate fact from fiction, and to strike a midway course between the optimism offering on the one hand and the excessive pessimism prevalent on the other.

We are concerned with a brief consideration of the status and prospects of the trade of this country in relation to the struggle in Europe, but as an aside it may be observed that any close speculation as to the duration of the war is foolish at the present juncture. Precedent does not help us, the conflict being of an entirely new order: all that we can reasonably surmise is that the very magnitude of the operations to which the German Empire has committed itself will prove its undoing in a matter of months, however thorough its preparations may have been. At the time of writing, the allied forces of France and Great Britain are now in line preparing to check the enemy's encroachments, and, with the Russian army looming up large on the horizon, and British mastery of the sea already asserting itself in the re-opening of trade routes, we can only wait—firm in the conviction that the potent forces of might and right arrayed against the German war fiend must prevail.

Confidence the Keynote

In taking stock of present conditions, it is gratifying to find that loyalty and confidence are the keynotes of the situation. One may point to projects postponed, to establishments closed, to reductions of staffs and salaries, and so on; but, after all, these are not a fair gauge of the people's attitude. Nine out of ten employers are firmly persuaded that Canada's prospects are as sound as ever, and they are prepared to make a temporary sacrifice with a view to sharing in the greater harvest that will be reaped after the war. In this attitude there is the truest patriotism. It is not given to every man to fight, but to every man who cannot fight is given the opportunity to do his share in maintaining the productive power and business stability of his country.

By such eminent economists as Sir George Paish the view is taken that the present war will open up a tremendous opportunity for Canada and the United States. It is held that if the tide is taken at the flood it will mean not diminished but greater prosperity for us. Financial embarrassment must be experienced for a time, but this is an evil which will be common to the whole world. With the maintenance of ocean traffic and the opportunity to dispose of our farm products, the speediest recovery will surely come to Canada. New lines of activity will compensate in part at least for the depression in others. Far removed from the scene of hostilities, the internal trade of this country should suffer as little as any in the world.

Canada's Trade Mainly Within the Empire and with the United States

An examination of actual facts and figures cannot but be reassuring to the manufacturing interests of Canada. We find that in the fiscal year ending March 31 last our exports and imports represented a total value of more than a billion dollars—the greatest figures in the country's history. In this period a great stride was made in our exports, which amounted to nearly $432,000,000. The amount of trade done with the present enemies of the Empire was inconsiderable: our exports to Germany and Austria-Hungary combined amounted to less than four and one-half million dollars, while our imports from these countries were nearly four times as great. It is questionable whether it would not be in Canada's favor if the exchange of business were wiped out. Naturally the war will affect seriously the buying power of other European countries, but it must be remembered that our business with Europe constitutes only a small part of our external trade and that it is the other countries of the British Empire and the United States that are our best customers. Canadian exports to Continental Europe last year amounted to less than twenty million dollars, while our commerce with other parts of the Empire consisted of exports to the value of some $239,000,000, and imports amounted to $154,000,000—a total of $393,000,000. With the United States our trade consisted of exports amounting to $200,000,000 and imports valued at $411,000,000, a total of $611,000,000. Thus our trade with other parts of the British Empire and with the United States amounts to upwards of a billion dollars. With these things in mind and the knowledge that Germany's merchant vessels are being driven off the sea, one may surely conclude that ultimately the war will have a good effect upon British (including Canadian) and United States trade. Depend upon it that much of the German competition which British and American manufacturers have had to cope with in the past will be wiped out and that Canada will share in the transfer of the trade which Germany will undoubtedly lose.

In a sane, well-balanced consideration of conditions and prospects, we must not overlook the fact that one of the most certain results of the war will be a world-wide scarcity of capital for investment purposes. It is impossible to foresee in detail the far-reaching results of the changes that are taking place in the value of capital, but a natural outcome is that the carrying out of constructional works and public improvements will be considerably hampered. The activity will be all the greater when constructive enterprise finds its level. All the more vital is it for us to hold our ground.

The Ebb and Flow of Prosperity

Prior to the outbreak of hostilities, we had entered upon a period of depression. The explanation of this depression is not hard to find in economic theory. The value of all products is dependent upon the demand: while manufacturing facilities and outputs had been increasing by leaps and bounds there had been a number of extremely grave developments tending to diminish the demand. The greatest development of all, unforeseen though it was, was the preparation that was being made for the present war.

As a matter of fact, history shows us that trade depressions travel in cycles. Ever since England became a manufacturing country she has encountered an almost constant ebb and flow of activity in trade. Even in periods when there have been no outstanding disturbances like the present one, the cyclical movement has been definitely marked. It has been observed that from 1887 to 1896 the cycle ran in the order of revival, marked revival, prosperity, decline, depression, and slow revival; and from 1897 to 1906—prosperity, great prosperity, culmination of prosperity, slow ebb, depression, distress, revival, prosperity. History establishes clearly that the cyclical movement is part and parcel of the normal system of industry.

Encouragement from the Past

After the Napoleonic wars one hundred years ago, it was not long before England was on a quick run to prosperity. Marked improvement took place in almost every branch of domestic industry; funds rose, revenue increased, manufactured lines were in great demand, money was abundant, sales of land improved, gold re-appeared, and depression gave place to hopefulness and enterprise. We can glean encouragement from the leaves which record the experiences of other days.

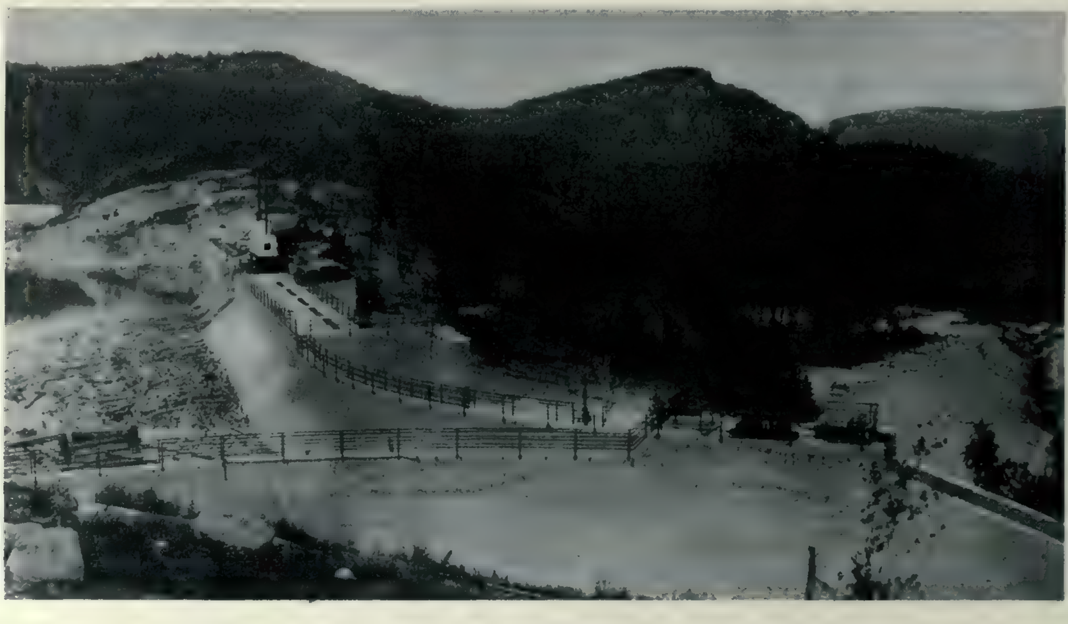
It is only to be hoped that that great majority of us whose faith in Canada's destiny is unalterable will rise to the present emergency by united effort and preserve the internal stability of the country. There is ample reason to hope that, even with a continuation of the war for some time, there will arise new demands for industry to offset those that are cut off. From now on the factories of Germany, France and England, depleted as they will be by the call to arms, will scarcely be able to meet the demands of home consumption. Here, then, will be the opportunity for Canada and the United States. Markets will arise in other parts of the British Empire, and these will be strengthened by a feeling of greater reliance in Canadian and United States products. "It is an ill wind that blows nobody good": possibly one of the most marked benefits that will arise out of this terrible conflict will be the stimulus afforded the manufacturing industries of the North American continent. The cessation of imports from continental Europe into Canada will give many home industries an unexampled opportunity for immediate development on an enterprising scale. Canada has a home demand which must be satisfied, and, with the untold natural resources of the country, we can look with confidence to the supply from within. Much of the new trade will be held, and so Canada will prosper at the expense of the belligerent countries.

We are persuaded that the greatest desideratum of the moment is confidence. It was the supreme confidence which Drake had in his fleet which enabled him to finish a game of bowls before he engaged the Spanish Armada—and the odds which Drake faced, with the Spanish fleet in the offing, were surely as great, in proportion, as the Empire is concerned with to-day. If, as time goes on, Britishers show themselves possessed of that calm self-control which is so essential to success on land or by sea, in peace or war, their destiny will not be shaken by the outbreaks of a dozen crazy fanatics like the Emperor William. We of Canada to-day share with the rest of the Empire the responsibility of showing that confidence which will not only inspire courage in recruits for the front, but produce men of calm judgment at home to maintain our reputation as a well-balanced business community. We have the ships, we have the men, and we have the money. There is no need for us to be apprehensive of the present conflict. Let us look to business and avoid panic.

It has been recognized for some time that the results obtained by the sand blast in the testing of clay products are as indicative of value as the more usual tests. The main objections to this method hitherto have been the difficulty of standardizing and the cost of the apparatus. By using centrifugal force in place of compressed air a machine can be built which is free from these objections. Tests on brick and plate glass, using the new machine, show that results are comparable, more easily obtained and reproduced, and, if anything, more reliable than the combined tests, particularly in respect of the grading of manufacturers and users. Results so far obtained indicate that sands of widely differing origin may be used and that further experimentation will produce factors which will permit the adoption of this machine as a standard instrument.

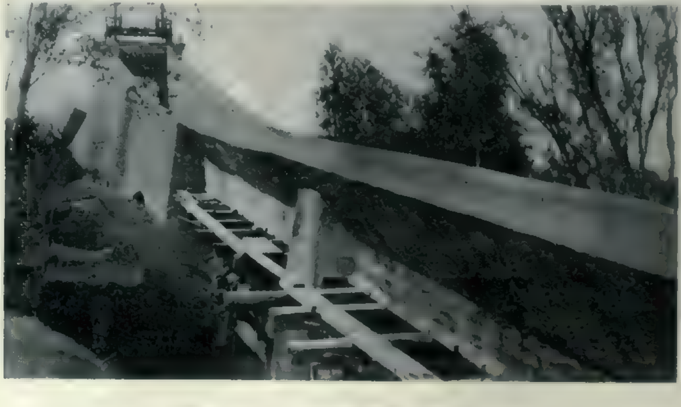
A Reinforced Concrete Log Chute and Dam at High Falls, Quebec

THERE has recently been put into successful operation by the Jas. McLaren Lumber Company, Limited, of Buckingham, Que., a reinforced concrete log chute, the only one of its kind in Canada—and perhaps in the world. The structure is at High Falls, on the Lievre River, in Quebec, and it is reported to have been in satisfactory operation for several months. From the standpoint of efficiency in delivering the logs, it is said to have recorded a great advance over the old timber chute which it replaced. The Lievre River is a stream of good volume and drains an area of 4,000 square miles. At the approach to High Falls it flows over a bed of granite and the sudden drop at that point is about 160 feet. At the head of the Falls the stream is naturally divided into two channels by a rocky island. The smaller of the two is the north channel and in nature the main or south current discharged itself over a rocky precipice in a white foaming mass. The safe delivery of logs over such a place was impossible, so for years they had been carried down in an old rectangular-bottomed timber-built chute. In 1910 the lower section of this structure went out, after doing duty for many years. In planning a replacement it was thought that the fact that the MacLaren limits could be made perpetual justified a permanent structure. The Company then decided upon a concrete chute to replace the old one and the discussion of the details concerning it revived a long-cherished desire to so improve the advantages of the splendid water power that it might be utilized so soon as a profitable opportunity presented itself. So in making the designs for the new chute it was incorporated as part of a large and excellent scheme of conservation and development.


Dam and log chute at High Falls.

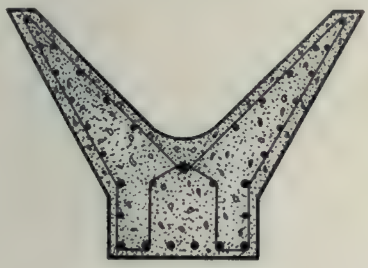
The scheme included two dams. The more important was across the main or south current. In it were the log chute outlet, the flood gates and provision for five power flumes each capable of furnishing water for a 10,000 h.p. unit. The north dam was designed as a regulating dam and was so constructed as to provide

North dam at High Falls on the Lievre River, showing outlets for flood water overflow.


Upper section of concrete log chute.

escape for the discharge in the case of exceptional high water. The log chute was placed to the south of the whole structure.

In 1910-1911 the lower section of the new concrete chute was built and connected with the old section above. As the workable structure thus stood, it comprised 375 feet of concrete and 1,500 feet of timber. Economy in the use of water had to be a guiding principle, as the more water went over the slide the less there would be for power. The V-shape was therefore adopted for the chute, as it was considered by far the most saving and adaptable. The design of the chute took into consideration the natural narrowing of the current in the gathering speed of the descent and the height of the sides were gradually decreased towards the foot. The maximum slope of the chute was fixed at 1 in 4, except at the lower end. There, about forty feet from the mouth, the gradient was sharply lessened and changed from a straight line to the arc of a circle of 225 feet radius. The change of grade being near the point of discharge, the retarding of the speed was so small as to be negligible and the result as designed was to throw up the lower end of the log and cause the drop to be made horizontally to the water. The upper end of the concrete chute was finished in July, 1912, and used for the discharge of the logs that year, but it was not until the completion of the whole work that the full efficiency was realized. This year the working of the permanent structure has more than justified the expectations of the engineer and the company. The new structure uses less water, discharges more logs and requires fewer men. The old slide required from fourteen to sixteen men to operate it and it discharged from 12,000 to 15,000 logs in ten hours. The new slide can be worked by six men and will discharge 50,000 logs every ten hours. The velocity of the logs in the 1 in 4 grade has been calculated to be 55½ feet per second. The total length of the slide over all is 635 feet. Its pier supports number eight. The admission gate for the logs consist of pine stop-logs bolted together. They are ten feet long, twelve inches thick and twenty-four inches deep, and are lifted and lowered by a hand winch.


Typical section of log chute.

Everything about the structure is of the most permanent nature. When the foundation trenches were blasted for the dam a ledge of the country-rock (grey granite) was left and against this the footing of the dam abuts. The dam has three regulating sluices. The piers between them are approximately in the shape of a long ellipse. The stop-logs for the regulating sluices are of Douglas fir and are twenty-two feet long, thirty-six inches deep, and vary from fourteen to twenty-two inches in thickness. The stop-log winch for handling them is operated by a two-cylinder steam engine which was built by the Victoria Foundry Company, of Ottawa.

The five entrances to the power fore-bay are submerged sluices covered by a reinforced concrete apron to prevent logs from being drawn in. The apron turns the logs to the slide and is carried sufficiently low to be below the point of lowest water. The draught to the power sluices cannot therefore affect the logs and the dam is so constructed that they are brought to the slide at all levels of the water.

The plans for the full structure were made in 1911 and the contract was let to Messrs. Haney, Quinlan & Robertson for the construction of the new dam and the completion of the log slide. Pouring concrete was started in the spring of 1912. In the whole work there are 100 tons of steel and 21,400 cubic yards of concrete. The total cost of the structure was $250,000.

The work here described is but one of several important power development structures that have been designed by Mr. J. B. McRae, of Ottawa, the engineer for the work. One of them is the dam and power-house at Ragged Rapids on the Severn River, which were built for the town of Orillia. Mr. McRae designed the dam and power-house (now building) for the Electric Reduction Company, at Buckingham, Que. He was also associated with William Kennedy, Jr., in the design and construction of the splendid dam at the Chaudiere Falls on the Ottawa River, which was undertaken for the large group of power owners of the cities of Ottawa and Hull.

Bonding Asphalt to Concrete

Among the several problems to be met in the recent construction of the concrete reservoirs in San Francisco was that of bonding asphalt to concrete. According to B. N. Abbott, in a letter to Engineering Record, after making unsuccessful attempts to apply the asphalt direct to the concrete in various ways, the expedient of first painting the surface with coal tar was tried, and it was found that when applied in this way under right conditions the asphalt would adhere so firmly that after it had cooled it could not be broken away without bringing pieces of concrete with it. Mr. Abbott states that in order to secure this result the concrete surface was first scrubbed clean with a bristle brush, and over this a thin coating of hot coal tar was "painted." The coal tar should be heated in small quantities, brought just to the boiling point and then applied immediately. Heating the coal tar in large quantities, which necessitated some delay before it could all be used, did not give such good results, and the gangs were therefore not allowed to heat more at a time than they could apply quickly as soon as it began to boil. The asphalt was spread over the tarred surface in the usual manner.

In Turkey, where cement is not used or is hardly known, a substitute has been found that has met with rather good results, when applied in exposed places, in filling crevices in water pipes, covering joints in stone floors, in fountains, and for numerous other purposes where cement would be required. It is stated to be as satisfactory in water as in exposed places, but it must be allowed to become thoroughly dry before it is submerged. The mixture is slaked lime, linseed oil, and cotton fibre. Generally a hollowed-out stone is used, although a flat, hard surface will answer, and the process is started by pouring the oil on a handful of cotton, after which the lime is dusted in. It is then kneaded until the whole is thoroughly mixed and about the consistency of dough. The more it is kneaded the better it becomes.

Efficiency and Economy in the Design of Factory Buildings*

By W. E. King

THE economical design of factories involves the solution of a large number of simple engineering problems. It is the intention of this paper to discuss these problems in their relation to each other in order to give a general view of the economics of this form of construction.

Factory design requires a broader knowledge of engineering than for most types of buildings. For this reason it is the work of an industrial engineer rather than an architect.

The industrial engineer should be an engineer with a fair working knowledge of architecture, civil, structural, mechanical and electrical engineering. It is essential to the economical design of any building that is to house machinery and human beings doing work which involves repetition of the same act that the designer of that building should have a very clear working knowledge of all the machinery installed and the processes which are to be carried on in the finished structure.

In organizations which do a considerable industrial engineering business it is customary to maintain engineers familiar with the various manufacturing processes. Such an organization usually maintains mechanical, electrical, civil engineering and architectural departments.

A purely engineering organization will tend to minimize the importance of the architectural requirements of the work devoting its time to the considerations of economy of construction and efficiency of operation. Both phases of the question should be considered in the design of any building, but certainly the aesthetic considerations in the design of a factory are not as important as the parts of which the study must necessarily be made by an engineer.

Whatever may be the title by which the designer of such a building be called, it is at least fair to state that all parts of the structure should actually be designed in his office and such work be paid for by him as a part of the service for which his clients pay him. The practice of some persons in the business of forcing the contractor for structural steel, or reinforced concrete, or other parts of the building to prepare the designs is certainly unfair to the client. There are other disadvantages in allowing the contractor to do the engineering.

Location

The work of the industrial engineer should commence, if possible, before the location of the factory is determined upon. The first consideration is, of course, the proper locality for the industry. This is largely an economic problem which the engineer may or may not be required to study.

The cost of any manufactured commodity to the retailer consists of the following items: Cost of raw materials, cost of the transportation of these raw materials to the factory, cost of labor on materials, cost of power, overhead charges, including interest on money invested, depreciation of plant, insurance, office time and advertising, cost of distribution and profit to the manufacturer.

Assuming the price to be received for any finished commodity to be fixed by competition, then that project which will pay the largest profits is, of course, the one where the sum of the first six charges is a minimum. This does not necessarily mean that any one item should be reduced to a minimum, but that the sum of all the items taken together is the least possible. The usual difficulty is that some one man almost always plans each project with the idea of reducing some one item to a minimum. For instance, a man who had spent the larger part of his time in handling of workmen will insist that the plant be so located that there will be an abundance of cheap labor. If he had at one time been a purchasing agent he would plan his plant to save all freight possible on raw materials. The sales manager is interested in the location of the factory with respect to the market. The man who furnishes the money is sometimes unduly interested in cutting the first cost down to a minimum, without regard to whether the interest on his money might be larger if more money were invested.

It should be the duty of the engineer to study these questions and to present them so that they will occupy their proper rank of importance. This rank is, of course, different in different kinds of factories. In the fabrication of structural steel, for instance, perhaps the most important factor is freight. This includes freight from the rolling mill to the factory and freight on the finished product from the factory to the consumer. In some parts of the United States this freight amounts to more than half the cost of the finished product. However, in the manufacture of candy, for instance, the freight is of small importance and the proximity to the market and the cost of labor is of greater importance.

Use of Charts

Where freight is one of the chief considerations, charts may be prepared showing the zone in which a product may be profitably marketed. The boundary of each zone will be determined by considering the sum of the freights on raw and finished materials for the proposed location as compared with other possible locations. The properly prepared chart will show the overlapping territories where competing factories sell on an equal basis. It will show the area where the factory in question has the advantage and it will also indicate the areas which cannot profitably be reached.

The matter of available market probably reaches its greatest importance when the capacity of a profitable factory is about to be increased. It may be that the selling organization is now reaching all of the profitable market zone and that to increase the sales the product must be marketed at a disadvantage.

Some industries use large amounts of fuel or power which requirement is the determining factor in their location. Many of our rolling mills are located at Pittsburgh because of available coal supply. The cheap water power at St. Anthony Falls partly determined the location of our flour milling industry. This tendency to group factories around water power sites will probably not be as marked in the future because our modern methods of electrical transmission allow power to be delivered economically at a considerable distance.

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*From a paper delivered before the Civil Engineers' Society of St. Paul.

Having determined on the vicinity where the factory is to be built the next consideration is the purchase of the exact site necessary for the project. The exact area of land which is necessary is usually a troublesome one. Most successful projects are hampered by lack of room to provide for their growing needs. On the other hand, it is a serious handicap to a young industry to be burdened with heavy interest charges and taxes on land not at the time in use.

The size and shape of the area necessary for present needs is usually determined by making a preliminary plan of the whole project. If the engineer is unfamiliar with the need of the industry in question, this will usually involve quite an extended study of the methods of manufacture used by the particular organization and of similar organizations in other places. If, however, the designer has already prepared plans for other similar plants the tentative preliminary plans involve only a study of the peculiar requirements of the special case. This preliminary plan should take in the reasonable growth of the industry, which usually may be approximately obtained by a comparison with similar industries in other communities. With the approximate area required clearly in mind a search of the locality will usually show a number of available sites. For projects of some importance plans are usually prepared showing how the proposed sites may be developed. These plans should show the approximate grades and elevations of all adjacent streets, the location of sewer, gas, water and power connections and the available connection to adjacent railroads or sidetracks. If grading of streets or of the lots will be necessary this should be estimated and added to the comparative price of the lots. For the purpose of comparison the cost of the sidetrack, including necessary grading, the cost of sewer, water, gas and power connections should be obtained. Very often the owners will buy a lot first, without considering the cost of those items which must be added to make the lot available, and in so doing they fail to get the most economical site. Plans showing the proposed sidetrack should be submitted to the railways interested and assurance should be had from their engineering and contracting departments that they are willing to put in the desired connection. If the side track must cross the public road it is well to be sure of the permit before putting money into the lot.

Side Tracks

At this time a study should be made to determine the number and length of side tracks which will be required. In general the track should be long enough to hold as many 40-ft. cars as the company will need to load and unload in any one day. In isolated places where the cars are not set as often as that, the side track must be long enough to allow for all the unloading and loading which must be done between each setting by the switch engine. Side tracks for loading and unloading should in general be level. The rules of the railroad in question, of the state and interstate railway commissions, and the state labor laws are the determining factors in the amount of room required for side tracks.

Building Plans

After the exact location of the site is determined then the plans of the buildings may be prepared. It is, of course, a mistake to make the final plans of any building before its definite location is settled. The natural grades of the land itself, the streets, the points of the compass, and the condition of the sub-soil almost invariably change the plans to such an extent that they must be revised or re-drawn. All of these conditions should be determined by an exact survey before work on the plans commences.

As before stated, the basis for the design of the factory building should be a complete understanding of the processes to be carried on in the building. Too many factories are built first and the machinery just put in, one piece at a time, after the building is completed. This usually results in the uneconomical use of the floor space; unusual spaces occur in some parts and a congested condition results in other parts.

The first plans to be prepared should be complete machinery plans. A study should be made of the progress of the materials through the shop. In general the manufacturing process should be so arranged that there will be no lost motion. The various materials which go to make the finished product should all travel through the various parts of the factory in such a way that they will arrive at the assembling room without having been transferred more times than is absolutely necessary. After leaving the assembling room the materials should go by the shortest possible route to the storage and shipping rooms. This part of the work is best planned with the prospective superintendent of the shop. It is sometimes difficult to get the benefit of this man's detailed knowledge and experience without letting his narrowness of viewpoint blind the designer to the broader phase of the question.

As a rule a good factory superintendent has spent the larger part of his life in some one factory. He probably has made that factory a success. That leads him to think that he knows all there is to know about that business. At least he thinks he knows more than any engineer whom the owners can hire. That is generally true, but his difficulty is that he is so close to his job that his perspective is warped. For instance, if ten years ago he tried a belt conveyor in his factory which he bought and installed improperly himself, and then afterward abandoned because it did not do the work required, he is convinced that he does not want a belt conveyor in his new factory. The fact that belt conveyors have been improved since he tried them and that there are thousands of them working satisfactorily under similar conditions, will impress him only if you can overcome his prejudices. If you can make him feel that he and the engineer are working together to get the best possible design and that you realize the value of his suggestions, then, generally, it is possible to get him to listen to yours.

It is a common thing to have one of these so-called "practical men" say: "You build me a building so big and I will put the machinery in myself, without any plans." Even with a man competent to do this, there is considerable advantage in arranging the machinery on paper first. It is easier to see where the waste spaces in the room occur and to correct them on paper than it is with the full-sized building. Then, too, these machines usually have foundations, shafts, electric wiring, and these things have a tendency to interfere with each other and to require the cutting of unsightly holes in the completed building.

The building should be built to suit the machinery. The columns and beams, the height of storeys, the location of heating and plumbing pipes, the sprinkler system, and the natural and artificial lighting should all be aranged to suit the machinery.

The economical arrangement of the structural parts of the building should also be taken into consideration in the arrangement of the machinery. If possible the columns should not be spaced to suit special machines unless there is some very decided advantage in doing so. It must be remembered that the life of a building is several times the life of the machinery installed and that the machinery of the future may be entirely different.

Types of Factory Buildings

There are two types of factory buildings which are here considered separately. The first is the ordinary one-storey building with a hip roof which may or may not be surmounted by a monitor. It usually has large unobstructed floor space to provide for the movement of cranes and other large machinery. The second type is the warehouse type of one or more storeys in height. Industries which require a clear floor space of more than 25 ft. in either direction are usually housed in one-storey buildings, because it is expensive to carry the weight of upper floors on long spans. Where the materials manufactured are of such size that columns spaced from 16 to 25 ft. on centers are not objectionable the building of several storeys is usually more economical.

A one-storey building costs the most per square foot of floor area. This cost per square foot decreases somewhat with the number of floors built, up to four storeys. Above that height the cost per square foot gradually increases. There is comparatively little difference in the cost per square foot of floor area between a three-storey and an eight-storey building.

If basement floor space is suitable it is the cheapest which can be obtained, except where the loads to be carried on the first floor are extremely heavy. A one-storey shop building in fireproof construction will cost from $1.25 to $2 per square foot of floor area, depending upon the height of the storey, depth of footings, lengths of spans and kind of exterior finish used. Fireproof buildings of more than one storey may be built for as little as 50 cents per square foot of floor area. These approximate figures do not contemplate any sort of plaster or interior finish except whitewash. They do include a properly finished cement floor. The cost per square foot of course decreases as the size of the ground plan increases. It is more for a long, narrow building than for a square building. However, a factory building should not be made too wide on account of the difficulty in properly lighting the interior. For ordinary factory work from 40 to 50 feet is the best width. A building of this width can be lighted with a storey height of from 12 to 14 feet. If the width of the building be made from 75 to 100 ft. then the storey height should be increased to from 14 to 16 feet, the windows being placed as high as possible.

One-storey shop buildings are usually built of what may be termed semi-fireproof construction. They are usually built of materials which will not burn but cannot be said to be entirely fireproof because the steel trusees are usually left unprotected, so that they might be damaged in case of fire occurring in the contents of the building. As before stated, the one-storey plan is usually adopted where large, unobstructed floor spaces are required. This results in long-span steel trusses supporting the roof.

The most common type of roof is the "A" shaped roof. This roof has many advantages. It is easy to keep water tight, it clears itself of snow easily, and with monitors or ventilators at the peak it provides good ventilation for the factory. If these monitors are made wide enough and are provided with windows they admit considerable light, but if the building is high and wide, monitor windows usually do not admit a satisfactory light.

A better type of roof, where light is essential, is the saw-tooth roof. This roof is made up of a series of pitched roofs, rising towards the north and stepping down with a vertical step, in which windows are installed. These windows, facing towards the north, admit a diffused light which illuminates the floor below without casting shadows. If the windows in the saw-tooth construction are arranged to swing, they provide as good ventilation as the old monitor type. The disadvantage with saw-tooth construction is that it presents a number of valleys where snow may lodge. In some cases steam pipes have been installed to melt the snow. This serves the purpose, but it is rather expensive. In buildings where there is considerable steam in the air condensation gutters are necessary under monitor and saw-tooth windows.

The Roof

The most unsatisfactory problem in shop building is probably the roof. It first must be watertight; second, if the building is to be heated in winter it must be of such material that condensation will not occur on the underside; third, it should be fireproof; fourth, it must compete with a large number of cheap roofs which are lacking in one or all of these qualifications. A standard roof construction consists of 3-in. hollow book tiles laid on steel T-beams. These tiles are covered with some good prepared roofing which is cemented and tacked to the tiles. This roof is very expensive, but it fulfills all the requirements stated above. It costs, including supports, about 30 cents per square foot.

Another good roof consists of 2-in. dressed and matched sheathing, laid on wood or steel purlins and covered with a good prepared roofing. It is practically as good and much cheaper than a book-tile roof, but, of course, is not fireproof. It will cost about 20 cents per square foot, including supports.

In some cases a thin concrete slab laid on steel or concrete purlins has been used. Considerable condensation occurs under such a roof in cold weather. Furthermore, it is very difficult to keep a thin roof slab from being damaged by frost while being laid in cold weather.

If the shop is not to be heated in winter corrugated iron laid on steel purlins makes a very inexpensive fireproof roof, costing about 12 cents per square foot in place, including supports. It is fairly water tight but, of course, is very cold in winter.

There are, of course, many other kinds of roofs, but the price of any roof comes between the limits here given.

There is not so much choice in the materials for constructing the side walls of a building as the roof, although they may be of brick, stone, concrete, corrugated iron or glass. Buildings with high storeys are usually made with steel frames, the walls being simply curtain walls, bricked in between the columns. Hollow brick should be used for the inside layer to prevent condensation of the side walls.

Concrete for side walls is often more expensive and is less satisfactory than brick. Concrete blocks are sometimes used and are satisfactory where enough cement is put in the blocks. Such walls are, however, weak, due to the lack of bonding between the blocks.

A 12-in. common brick wall in this part of the country will cost about 38 cents per square foot in place. With a good facing brick and some architectural decoration the cost may be increased to from 40 to 60 cents per square foot.

In the modern factory building the selection of the material for the outside walls is not such an important feature because from 75 to 100 per cent. of the wall area is occupied with windows and doors. The old style shop building did not, as a rule, admit enough light. Some of our new buildings probably admit too much. It is a mistake to assume that a workman needs as much light to work by as there is out under the open sky. Too much light is almost as bad for the eyes as too little. Most of the inconvenience of working indoors comes from working with a strong light from one side which casts shadows. Windows should be so arranged that light will reach every point from at least two directions and be of as near the same intensity in both directions as possible.

Another question upon which there is usually some argument is the kind of windows to be used. The three types most used are the standard wooden sash, the rolled steel sash and the fire undrewriters' sash of sheet steel or copper. The underwriters' sash is very little used for shop buildings because of its high cost. It will, however, greatly reduce the insurance rate upon such walls of the building as have a bad fire exposure. Underwriters' sash cost about $1 per square foot, glazed with ¼-in. wire glass and set in place.

The most satisfactory sash at the present time for factory work is the rolled steel sash. Where large areas are to be glazed the small size of the steel muntins and mullions permits the maximum amount of light to enter the building. Several factories have been built with the side walls almost entirely of glass, the only obstruction in the walls being the columns and the brickwork at the floor line. The cost of steel sash set in place and glazed with double-strength glass runs from 40 to 45 cents per square foot, depending upon conditions. A steel sash has a few disadvantages which should be taken into consideration. The ventilation is usually secured by pivoting a part of the sash near the middle. In factories where screens are necessary it is not possible to have ventilation because the screen will not permit the ventilator to swing. In northern climates a storm sash is desirable because of the loss of heat through the glass by conduction. A steel sash is too heavy and too expensive to use for storm sash. If wooden sash be used the advantages obtained by the use of steel inside sash are lost.

The cheapest sash to use is undoubtedly the double hung wooden sash with which we are all familiar. Its cost is from 25 to 50 cents per square foot, in place. It allows of 50 per cent. opening for ventilation. The details of window openings and their connections to the remainder of the building have been worked out through long use and can be made to fit any opening without additional cost. Where the window areas are large the wooden mullions and muntins must be made of considerable size for strength. This results in a considerable obstruction of light.

General Classes of Factory Buildings

Considering factory buildings of more than one storey, they naturally divide themselves into four general classes, according to the materials of which they are constructed. This classification is really made by the fire underwriters inasmuch as the different types take different insurance rates. In fact, the rate of insurance is the consideration which most often determines the type of construction.

These classes are: Frame construction; slow burning timber construction; structural steel; and reinforced concrete.

In the frame construction class should be included all buildings having either brick or timber walls, wherein the floors are of wood and the joists are narrow and closely spaced. Such buildings are, of course, the cheapest which can be built. By far the larger number of the present factory buildings are of this type. When an industry is in an experimental stage, and where the processes of manufacture and the machinery are likely to be changed with experience, it is more economical to build in this manner. If a building is anything more than a temporary structure the extreme fire hazard, the danger of employees upon the upper floors, and the lack of rigidity for supporting machinery are disadvantages which should be taken into consideration.

The insurance rate for frame constructed factories without sprinkler systems varies from $1.25 to $2.50 per year per $100 of insurance. The value of the contents of the building may equal that of the buildings, and the rate on the contents will usually not be less than on the building.

If the frame type is to be used the insurance rates may be reduced about 60 per cent. by the installation of the standard sprinkler equipment. This equipment will cost from 5 to 15 cents per square foot of floor area, depending upon conditions. That is, in a cheap building the cost of the sprinkler equipment will add to the cost of the building from 10 to 20 per cent., but this cost is usually paid for in the first few years by the decreased insurance rates.

There is another loss to be considered which cannot be covered by fire insurance, namely, the loss of profits due to the interruption of business. This includes not only the current profits but also the loss of customers. In a growing concern this loss is generally more serious than the damage done by the fire.

In the slow-burning mill building construction, as described by the fire underwriters, the walls must be of brick or stone. It differs from the frame construction in that the joists are spaced from 3 to 6 feet apart and are timbers of considerable size. The floors are matched planking. All stair and elevator hatchways must be enclosed, with doors at each floor opening. This construction is somewhat more expensive than the frame construction. Its principal advantage is that it takes an insurance rate about 20 per cent. less than frame construction. If a sprinkler system is installed this rate may be reduced to about 48 cents. The first cost of the building will be from 10 to 30 per cent. more than for frame construction, with brick walls.

Any timber construction has several advantages over more permanent types, such as concrete or steel. Alterations in the buildings, due to changes in processes of manufacture and to the installation of new machinery, are much more cheaply and rapidly made. The expenses of attaching shafting and machinery to the finished structure is considerably less. Wooden buildings are much more rapidly constructed than either reinforced concrete or structural steel buildings.

The columns in buildings with wood beams should be spaced from 12 to 18 ft. on centers. If a greater column spacing than this is required it is usually more economical to make the beams which span the longer direction of steel. These beams may rest on cast-iron or steel columns, the remainder of the construction being of wood.

A better construction consists of steel columns and beams throughout. The floors may then be made of reinforced concrete or tile. If the columns and beams are then covered with fireproof material such as tile or concrete the building may be regarded as the best type of building which modern civilization has produced. It is also the most expensive, costing from 5 to 20 per cent. more than a reinforced concrete building. In such a building the steel columns do not occupy so large a percentage of the floor area as do concrete columns. Exact stresses in a steel frame building are more easily computed. The chance for variation in the strength of the material due to faulty workmanship or design is not nearly so great. Alterations of the building are more economically made in a steel than in a concrete building. The insurance rate for such a building as compared with a frame building, taking a $1.50 rate, would be about 90 cents per $100 without sprinkler system. With a sprinkler system this rate would be reduced to something like 36 cents per $100. In fact, many buildings of this type take a rate of from 10 to 20 cents per $100.

The most popular type of factory building in the vicinity of St. Paul and Minneapolis is reinforced concrete. In this respect we are away in advance of other localities. In fact, we probably have a larger proportion of reinforced concrete factory buildings in the Twin Cities than any other locality in the United States. This is largely because there are a number of contracting engineers of unusual ability in this vicinity who are financially interested in the sale of the reinforcing steel entering into these buildings. Their influence is evident in the building ordinances of the Twin Cities, which allow higher unit stresses in both the concrete and the steel than are common in the cities of the east.

A properly designed concrete building is the best building which can be put up for many industries. It is entirely fireproof and takes the same rate of insurance as a fireproof steel building. Such buildings are probably the most rigid type which can be constructed. The material will stand a large amount of abuse in the way of faulty workmanship and design. Other types of buildings deteriorate with age, but a properly constructed concrete building increases in strength.

The floor spans of a concrete building may economically be made from 16 to 24 feet. The exact span for minimum cost depends upon the expense of the foundations. The more expensive the foundation piers the longer may be the economical span. We find that the flat plate type of column pier is considerably less expensive than the old-fashioned masonry piers of the pyramid type.

The statements made concerning the exterior walls of one-storey buildings are true in regard to buildings with a greater number of storeys. It is usually economical to build self-supporting, exterior walls for buildings up to three storeys in height. For buildings higher than three storeys the walls are often made 12 inches thick and are carried upon the steel or concrete frame of the building.

Water Sterilization by Ultra-Violet Rays

WITHIN the last five years a new field for the application of electricity has been created in Europe based upon the electrical production of ultra-violet light for the sterilization of water and for other purposes. As this new industry is now being introduced into this country, it is of interest at this time to analyze its basis and principles.

The only industrially-applied source of ultra-violet light is the mercury-vapor quartz lamp. The spectrum is known by its bright lines in the visible part and by a large number of typical lines in the ultra-violet part, as shown in Figure 1, which is drawn to proportional scale.

The most efficient way for the mercury lamp to react upon water seems to be to submerge the lamp entirely in the water which is to be sterilized. Direct contact, however, of the water with the heated lamp influences the luminous and ultra-violet efficiency of the quartz lamp to an enormous degree. It seems to be certain, therefore, that it is better, if one wants to plunge the light source into the water, to protect the lamp from direct contact with the water, and this system has been adopted with modern apparatus. This protection against direct contact can be secured by fusing over the lamp a wide quartz jacket which prevents contact of the light-giving portion of the lamp, with the water.

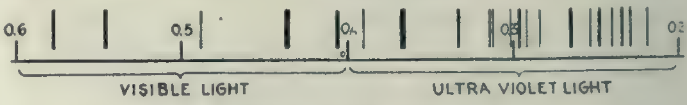


Fig. 1—Spectrum of mercury vapor quartz lamp.

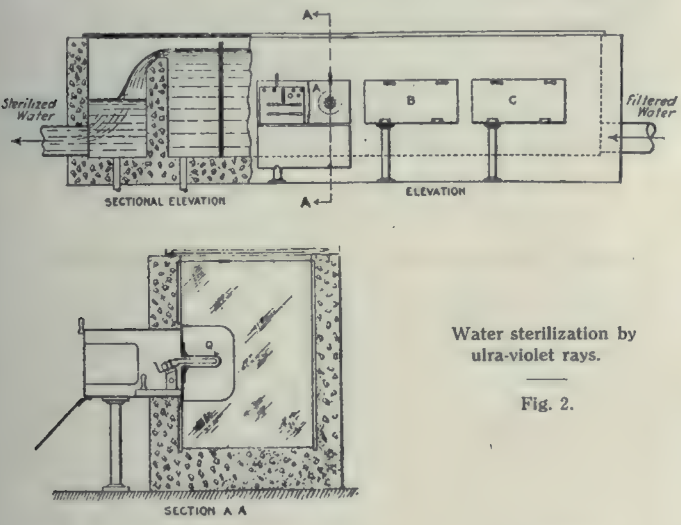
Difficulties, however, arose in the manufacture of such jacketed lamps and it was found advisable to construct the apparatus in such a way that the lamp was removable from the protective jacket, as shown with the so-called pistol lamps, Figure 2, allowing, nevertheless, all the light to enter the water.

Different germs have different sensibilities to the ultra-violet rays. The ones of greatest interest to us are the water bacteria, and we find that they are killed in as short a time as 1/20 second, at a distance one to two centimeters from the powerful ultra-violet ray lamps. Water being practically as transparent as air to the ultra-violet rays, we are therefore certain that if a germ floats in the water it will be annihilated by getting into the illuminated zone, the condition for this being that no suspended matter is contained in the water which would form a shield for the germ.

Water for this sterilization has, therefore, in most cases to be filtered before being submitted to the sterilizing action of the rays. However, even very good filters will allow some microscopic matter to pass. It is much more effective, as shown by experiments, to stir up such water while it is going through the illuminated zone so as to turn over and over any particles which otherwise might allow microbes to pass by under cover. The baffle arrangements as shown in Figure 2 are built in for this purpose of stirring up the water. For the same reason, also, it is best to pass the water through several illuminated zones, which can easily be done by leading the water several times towards the same source of light, or by passing it successively under several sources of light, as shown in Figure 2.

The largest unit ever built was set up about two years ago in the city of Luneville, France, to sterilize the city water supply. It consists of a flume into the sides of which ten 500-volt pistol lamp equipments are inserted. These equipments consist of metal boxes for the starting of the lamps (the latest types of them contain also the rheostats). The boxes are equipped on the inside with a stuffing box arrangement holding the quartz protective tube which protrudes into the water. The lamps are lit in the starting boxes and then their luminous parts are inserted into the protective tubes, so that the light emitted from the lamp enters the water.

The raw water fed into this plant comes from the Meurthe river and contains sometimes as high as 60,000 germs per cubic centimeter. It is clarified by a series of roughing filters and one filter. After this it is physically in fairly good condition, being very poor in suspended matter, but having from time to time fairly deep color (up to 45 U. S. standard) in solution. The germ contents are sometimes as high as 1,000 per cubic centimeter in this water. It is then passed through the sterilizing unit described above, coming under the influence of the light from one to two minutes altogether, according to the number of lamps running. This number (sometimes only 4) depends on the physical condition of the water, which is easily observed. The bacteriological tests of the water when leaving the sterilizer rarely show more than 10 germs per cubic centimeter and are often zero. Bacterium coli is always eliminated. Not only are the bacteriological tests satisfactory; the health of the community has improved considerably. Typhoid used to cause from 70 to 160 deaths annually; it is now practically eliminated, there being no cases at all this year.



Water sterilization by ulra-violet rays.

Fig. 2.

Another typical installation was made in New York lately for the purification of the water of a swimming pool, which is naturally exposed to continuous pollution from the bathers. The water in this case is circulated continually through a filter to take out suspended matter and then it passes through the ultra-violet ray sterilizer. This apparatus is similar to the Luneville unit except for its size, as it contains only two 220-volt pistol lamps. It is rated at 175,000 gallons capacity per day. Tests at the outlet of the sterilizer show only a few germs, and tests of the water going to the purifying apparatus have improved from 6,000 germs per cubic centimeter to about 350 germs per cubic centimeter since the introduction of the ultra-violet ray apparatus.

The smallest lamp used in the above apparatus operates at 110 volts with two amperes. The largest made so far is for 500 volts, 2.5 amperes. The largest apparatus built contains ten of the last-mentioned lamps. The power consumption in such a case, with a very large safety coefficient for the sterilization, is between 50 and 130 kilowatt-hour per million gallons of water. This amount of power is evidently not very great but it will always do something to smooth out the load curve of a power station, as, in most cases, such apparatus will be operated continuously. Many installations of this kind have been made in Europe for both small and large water works, and they are operating very successfully. Their simplicity and rapidity of action have proven highly satisfactory in all installations.

Cleaning Stone Work

A builder had a contract involving the use of brick work with granite trimmings and he found it necessary to clean the stone work. He made the attempt with dilute acid, but it did not give satisfaction, although the stock brick around the trimmings cleaned up very nicely. The granite, however, still showed the streaks of dirt. He stated his case in a recent issue of The Painters' Magazine and the suggested remedy was as follows:

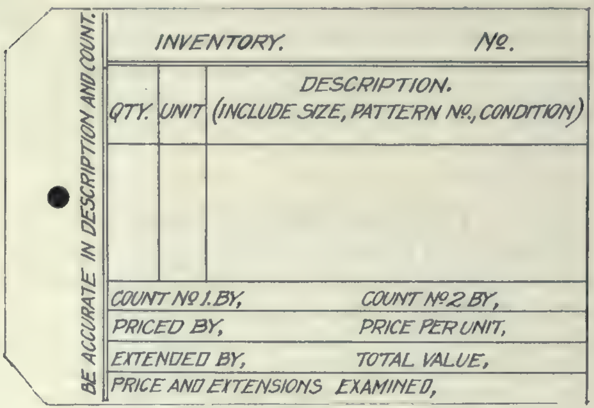
Builders' acid, which is equal parts of muriatic acid and water, will remove spots of mortar on brick or stone work, but is not the right material for cleaning stone that is begrimed fro msmoke and dirt. To accomplish this, apply to the surface, with a long-handled fibre brush, a strong solution of caustic soda or pearl ash. Let it remain on for about fifteen minutes, then wash several times with clear water, using a stiff brush or broom for the purpose. If this will not be effective enough, scrub the stone with a stiff fibre brush, using soft soap and concentrated lye and sand, allowing this to remain on the stone until nearly dry, then rinse with clear water, using a brush to remove the cleansing material.

A reinforced concrete pontoon, for a landing stage for ferry service, has recently been put into use in the harbour of Sydney, Australia. The pontoon is 100 ft. long, 43 ft. wide at one end and 68 ft. at the other, 7 ft. 9 in. deep, with a 32-in. freeboard. The bottom is flat, and the sides and ends are sloped to an angle of 70 deg. Special attention was given to the design of the reinforcement, with a view to enable the construction to withstand the excessive forces likely to occur should vessels be berthing at each side of the pontoon at the same moment. In the construction of the top and bottom of the pontoon, allowance has been made for a live load of 150 tons, which will be distributed over the centre length between the posts. The whole structure is divided into forty-eight water-tight compartments by solid reinforced concrete walls. It weighs about 650 tons.

The Organization and Management of a Stores Department

By W. G. Astle*

THE Stores or Stock Department of any business is that section which has the custody of its stock-in-trade, materials, supplies, and other physical property, except real estate. This department when scientifically organized and managed becomes one of the most valuable from a profit-making standpoint, but, without the proper organization and management it may degenerate into one of the most useless. The organization and system must be of the very best to attain the state of efficiency of which it is capable, and like every other department of a business, the organization depends largely upon the nature of the business.



INVENTORY. No.

QTY.	UNIT	DESCRIPTION. (INCLUDE SIZE, PATTERN No., CONDITION)

COUNT No 1. BY, COUNT No 2 BY,

PRICED BY, PRICE PER UNIT,

EXTENDED BY, TOTAL VALUE,

PRICE AND EXTENSIONS EXAMINED,

BE ACCURATE IN DESCRIPTION AND COUNT.

Fig. 1.—Inventory cards.

What is Material?

Material is the first great factor in the cost of a thing to the producer, and may be classified as Raw Material, Finished Commodity, and Accessory Material.

Raw Material may be defined as any material for use in process before it has been subjected to that process. Finished Commodity designates any industrial product which is introduced, without substantial charge, into the composition of another product, usually as an accessory part. Accessary Material is material necessary to a process, yet not actually entering into the completed product, and is commonly considered a part of general manufacturing expense, particularly if the material is used again and again, and not directly chargeable against any one particular job.

Two Types of Organization

The aim of any organization should be to systematically unite each individual into a body purposed to work together for one common end; to unite in reciprocal and concrete relation and duties; and to bring into systematic connection and co-operation parts of a whole. This is the first necessity of any organization, either commercial or industrial.

The elements of any organization are men, equipment, and space. You have an efficient organization when the elements are combined in such a manner that they will operate harmoniously, accurately and promptly, and will achieve the result required with the least expenditure of money and effort.

Organization can be divided into two kinds, military and functional.

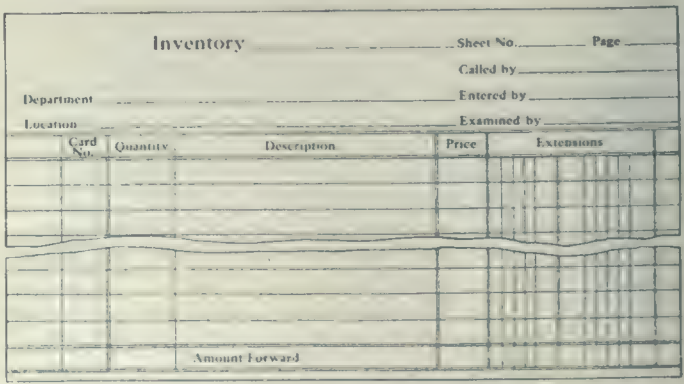
Functional organization is a type of organization that gives each worker, whether executive or clerk, as few functions as possible to perform. Major Charles De Lano Hine, in his book "Modern Organization," describes the unit system of organization employed on the Union Pacific Railway, which is a type of functional organization peculiarly adaptable to the railway business by reason of its scattered forces.

Military organization is a type of organization where one man has supreme authority over a branch of the company's work. Mr. F. W. Taylor, in his book, "Shop Management," points out that this type of organization is inefficient, because if the man's duties were properly fulfilled, he would actually be an expert in many branches of business knowledge. The foreman who hires and fires, plans the work, supervises the cost accounting system and has charge of new construction, operates under this plan.

The organization of a storeroom, however, will have to be modeled according to the conditions found in the individual establishment.

Scientific Management as Applied to a Storeroom

Scientific management has passed the stage of experiment and has firmly established itself in many of the greatest industries. Men have been slow to grasp the significance and tremendous possibilities of the scientific means of doing work in all branches, but the survival of over thirty years of a movement of this character through all the opposition, objections and difficulty strewn in the path of any innovation gives trustworthy evidence of the soundness of the ideas and a fair prophecy of their extensive application in the near future.



Inventory Sheet No. Page

Called by

Department Entered by

Location Examined by

Card No.	Quantity	Description	Price	Extensions
		Amount Forward		

Fig. 2.—Inventory record taken from cards, Fig. 1.

The physical aspects of a storeroom under this style of management do not differ very much from any well systematized storeroom. A proper means of storing and piling the material, laid out in an orderly fashion should be provided. To avoid confusion in a varied terminology, mono-meaning symbols should be used to designate the different kinds of material. The

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* Storeskeeper, Toronto Electric Light Company.

maximum and minimum should be determined for each kind and kept on the stock ledger sheets or cards.

Under this style of management it is not enough, when material is required, to send a requisition to the Stores Department, but all orders for work that require material should have the items booked up and assigned to the specific orders by the Storekeeper, and this material, when assigned to a given order, should not be available for any other orders which may follow. This should be done before the material is required for use and will serve as an advance notice to the Storekeeper should any unexpected demand for a particular material occur.

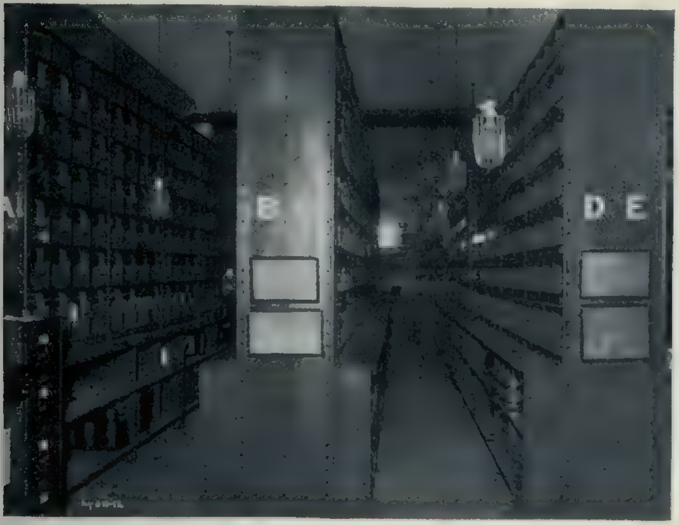


Fig. 3.—Storage adjustable shelving.

The work of moving materials into the storeroom and moving them to the particular place where they are to be used, becomes a function of the planning of the work, and of the routing of the work, and the man who is to use them should not be delayed or have to give a thought to the materials which he needs for his next job. They should be moved in the right condition for his use to the point where he can use them to best advantage. The time which the man spends looking or waiting for his material can be better spent in effective work.

Inventories

Before a system of stock records can be successfully installed, a complete inventory must be taken, and from this is formed the basis on which the records are founded. When once this inventory is taken and properly recorded, it is possible to install and maintain a system which will make it unnecessary to take an inventory of all the materials at any one time. The chief requirements of an inventory are exactness in description, enumeration, and appraisal.

Several gangs of men working together in different parts of a storeroom make it impracticable to take a consecutive list of the materials on hand, therefore it appears best to make the original records on cards, one for each lot of similar items. These cards, Fig. 1, should be numbered consecutively, and should be provided with a hole punched at the centre near the top, for attaching a string, as with the ordinary shipping tags.

Before beginning an inventory all the men should be called together and given instructions in the methods to be followed, and foremen should be selected for the various gangs and assigned to the materials with which they are the most familiar. They should also be instructed to commence at a suitable point and progress regularly. The foreman of each gang will then record the date for each lot on the cards, and check the count of his helpers, after which he will attach the card to the material. This procedure is followed until every different article in the storeroom is tagged. This is only a preliminary count and the work in the storeroom should not be interrupted to any great extent. The man who takes out any material should change the tally memorandum on the card for any lot of material already counted.

On the date decided upon for the inventory, the work should be changed around so that a different force of men will go over the work done by the gangs in the first round. This second gang will take off the cards attached to each lot, verify the condition and number, and proceed as rapidly as possible. It should not be necessary for this second gang to check every piece of material, but only to test occasional places at random, or to satisfy themselves in some way that the cards give an accurate record of the material they represent. When these cards are all checked and removed, they should then be sorted numerically, to make certain that they are all accounted for, after which they can be arranged in any way that will simplify the operation of pricing. After they have all been priced, checked, and arranged in whatever way desired, the inventory can then be typewritten on loose-leaf sheets, Fig. 2, and bound for future reference.

Perpetual Inventory Plan

The old custom of making inventories but once a year is fast becoming obsolete, due to the fact that under that system little opportunity is given to trace losses in any department, and to the difficulty of going over the entire amount on hand at any one time. A better arrangement, and one which commends itself to the practice of to-day is commonly called a perpetual inventory. To adopt such a plan, it must be first ascertained the number of kinds of material in stock, and a schedule arranged whereby a certain number of items are counted each day during the year, and compared with the stock sheets or cards; if necessary they should be immediately readjusted. The result of this method will be that no extra effort will be required, and the work can be done by the storeroom

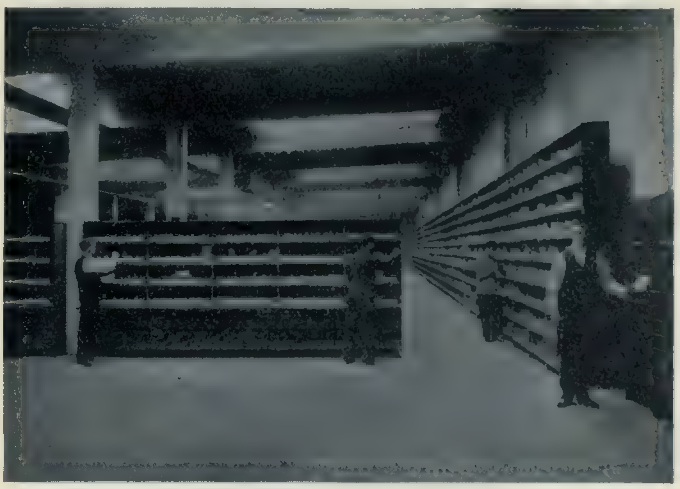
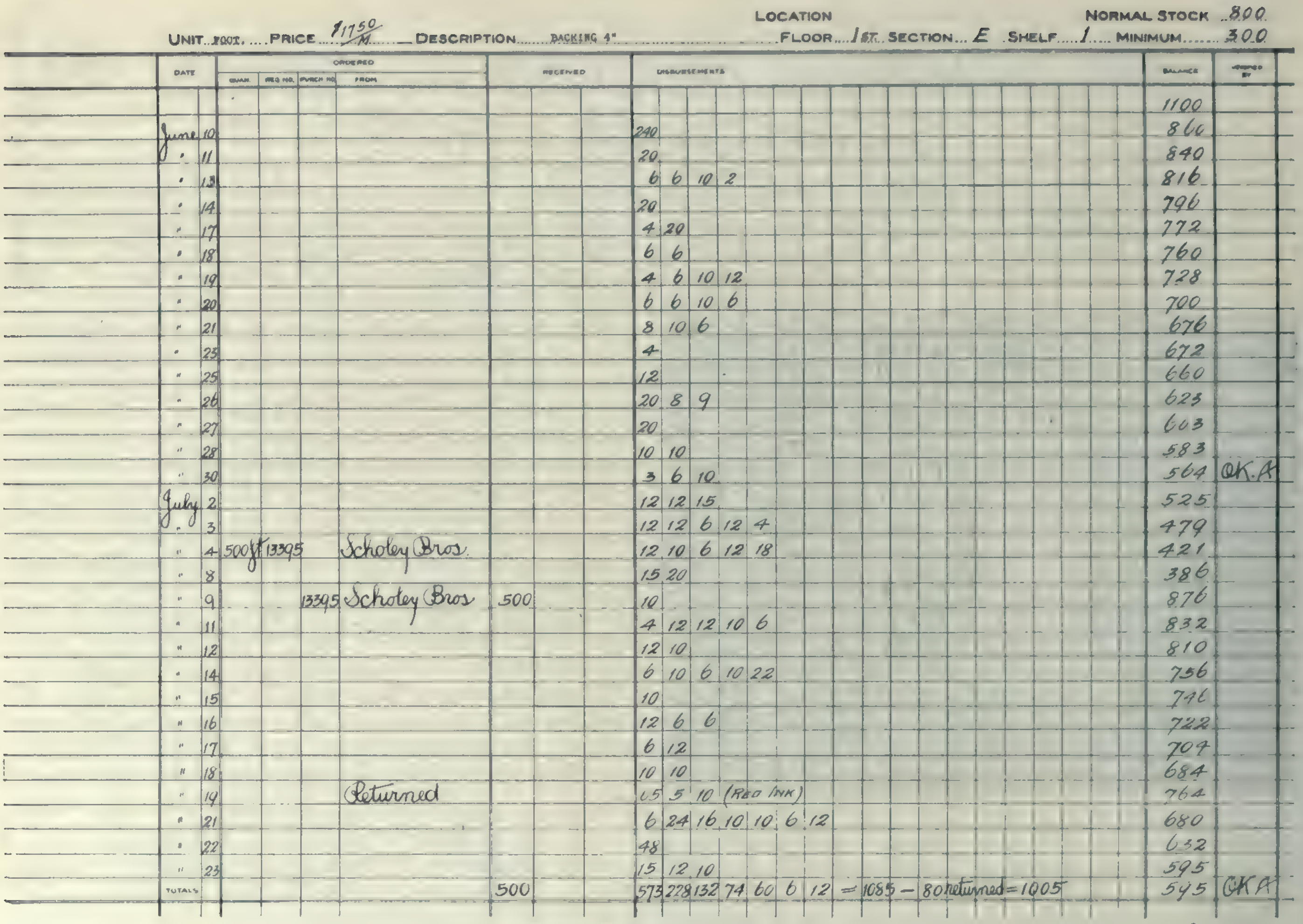


Fig. 4.—Storage adjustable shelving.



UNIT FOOT PRICE $17 50/M DESCRIPTION BACKING 4" LOCATION FLOOR 1ST SECTION E SHELF 1 NORMAL STOCK 800 MINIMUM 300

DATE		ORDERED QUAN.	REQ. NO.	PURCH. NO.	FROM	RECEIVED	DISBURSEMENTS	BALANCE	CHECKED BY
								1100	
June	10						240	860	
"	11						20	840	
"	13						6 6 10 2	816	
"	14						20	796	
"	17						4 20	772	
"	18						6 6	760	
"	19						4 6 10 12	728	
"	20						6 6 10 6	700	
"	21						8 10 6	676	
"	23						4	672	
"	25						12	660	
"	26						20 8 9	623	
"	27						20	603	
"	28						10 10	583	
"	30						3 6 10	564	OK.A
July	2						12 12 15	525	
"	3						12 12 6 12 4	479	
"	4	500 ft	13395		Scholey Bros.		12 10 6 12 18	421	
"	8						15 20	386	
"	9			13395	Scholey Bros	500	10	876	
"	11						4 12 12 10 6	832	
"	12						12 10	810	
"	14						6 10 6 10 22	756	
"	15						10	746	
"	16						12 6 6	722	
"	17						6 12	704	
"	18						10 10	684	
"	19				Returned		65 5 10 (RED INK)	764	
"	21						6 24 16 10 10 6 12	680	
"	22						48	632	
"	23						15 12 10	595	
TOTALS						500	573 228 132 74 60 6 12 = 1085 – 80 returned = 1005	595	OK.A

Fig. 5.—Stock Ledger sheets, showing only units.

staff, who are thoroughly familiar with the different materials handled almost daily in filling orders.

There is no real reason why an actual inventory should be required at any one time. If the Storekeeper has a check, from time to time, of the actual stock on hand to compare with his stock records, it is just as practical as though all his information was supplied to him at one time. On the other hand, this plan has many advantages in that it does not interfere with the routine filling of orders, it does not require the employment of additional help in the storeroom who are not familiar with the material in stock. In actual operation, the above plan is not only feasible, but it has proved most desirable from an efficiency and economy standpoint.

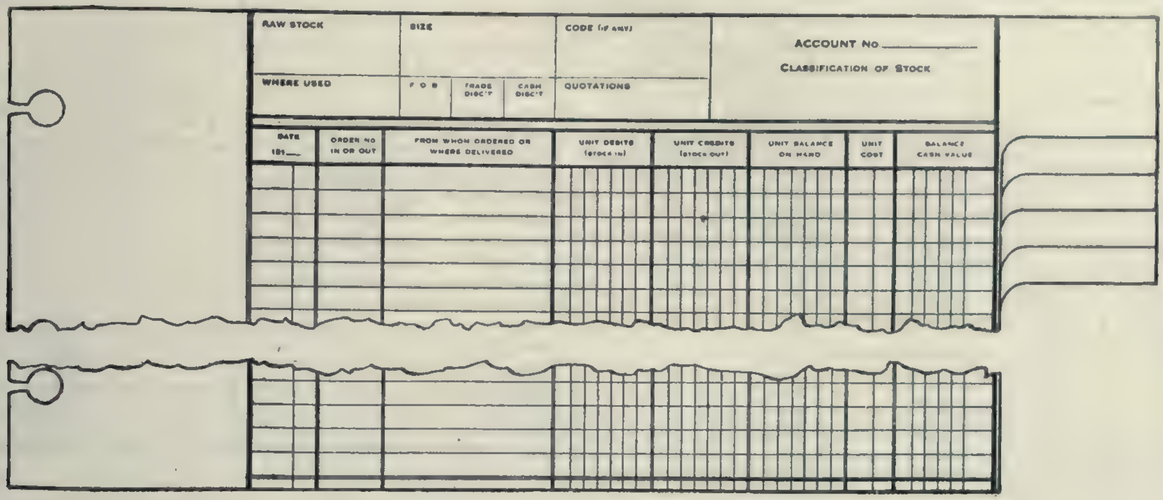
Storage, Shelving and Racks

This is one of the most important points to be dealt with when installing an up-to-date storeroom system, and very often there is not enough importance attached to this feature of storeroom facility. In quarters which are crowded, and have not the proper kind of storage bins and shelving, the difficulty of keeping track of the materials needed is increased. Materials will be ordered when a sufficient quantity is already on hand, but cannot be located; or some special line will be overlooked entirely until the last moment, when it is required. This item of storage is deserving of more than passing notice, for thousands of dollars will be spent, and maybe wasted, if great care is not exercised in keeping the supply of materials up to the requirements.

Nearly everyone will agree with the writer, that the advantages of steel racks and adjustable shelving over wooden equipment are very great. In the opinion of the writer, the best steel equipment for storeroom racks and shelving on the market at the present time is the "Lyon," Figs. 3 and 4, which are manufactured in Aurora, Illinois, by the Lyon Metallic Manufacturing Company. The main features in the "Lyon" racks are their strength, simplicity, and adaptability; they are fireproof, permanent and occupy much smaller space than the wooden equipment. They are made in standard sizes and one or more sections are complete in themselves, which enables you to gradually increase your storing facilities as business demands, or they can be taken down at any time and assembled in another position.

Each section of bins or racks should be given a letter and each individual bin or shelf a number, so as to enable the location of the materials to be specified on the stock records.

The question of what is a proper storage place and the laying out of the floor space is one which must be worked out to fit the conditions as found in the individual establishment. In a manufacturing business the materials should be located as near as possible to the departments in which they are used. In the larger plants it is sometimes necessary to have several storerooms to accommodate the various classes of material, and in order that they may be located conveniently. The question of proper storage is a vitally important one in every business, and especially so in a manufacturing plant. Ideal conditions are impossible to obtain in all plants, but the very first consideration should be to have a definite place for every class of material, and always keep the class in that one place. The question of the size and weight of the material, and the frequency with which it will be needed, should be the first consideration. Extremely heavy articles should not be stored on the floor, but should be raised to about the height of a truck, which will save labor in loading and unloading. Material which is constantly called for should be kept on shelves within easy reach. The top shelves and inaccessible corners should be reserved for the articles which are seldom called for. As far as possible, all material of the same class should be kept in the same location or section of the storeroom. Above all, a given article should always be kept in the same place.



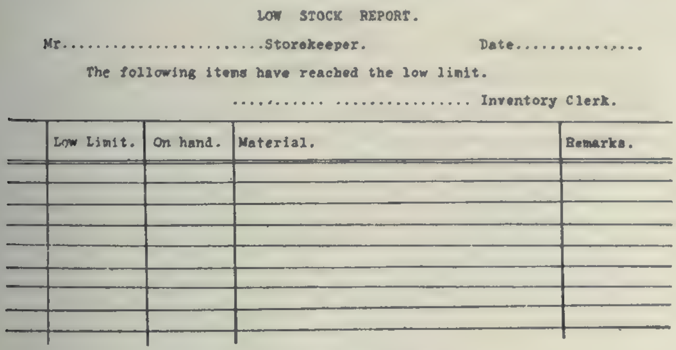
RAW STOCK	SIZE		CODE (IF ANY)	ACCOUNT No. ____________ CLASSIFICATION OF STOCK
WHERE USED	F O B	TRADE DISC'T	CASH DISC'T	QUOTATIONS

DATE 191__	ORDER NO IN OR OUT	FROM WHOM ORDERED OR WHERE DELIVERED	UNIT DEBITS (STOCK IN)	UNIT CREDITS (STOCK OUT)	UNIT BALANCE ON HAND	UNIT COST	BALANCE CASH VALUE

Fig. 6.—Stock ledger sheets, showing both units and values.

The Storekeeper and His Duties

The Storekeeper, under the direction of the Purchasing Agent (or in some plants he should be under the Superintendent) should have full charge and authority in the Stores Department. He should have charge of all assistants and storeroom clerks, and must render receipts to the Accounting Department for the entire intake and output of all material and supplies. All requisitions for material and supplies should be made by him, to the Purchasing Agent, and in some cases the requisition should be accompanied by a record of the material on hand at the time of requisition. He should be solely responsible for the maintenance of a perpetual stores inventory system, and for keeping it posted up-to-date. A storekeeper must, above all things, be exacting, and have such complete control over the men in his employ that the slightest infraction of rules will mean the equivalent to a final check. He should be a man exceptionally well qualified for the position, capable of protecting the company's property to the letter. He should be familiar with the materials, and know their uses, but it is not necessary that he should be a skilled mechanic. On the other hand, he should not be simply a bookkeeper, or he may be unable to suggest uses for certain material, and as a result, a lot of dead stock will accumulate, much of which might be employed for some purpose if brought to the attention of the proper parties.



LOW STOCK REPORT.

Mr.......................Storekeeper.   Date...............

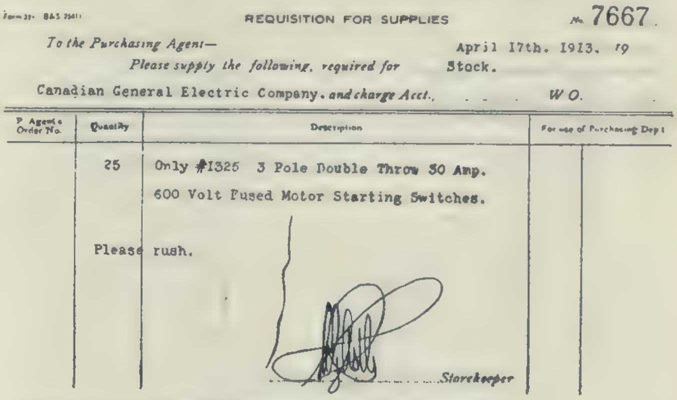
The following items have reached the low limit.

.... Inventory Clerk.

	Low Limit.	On hand.	Material.	Remarks.

Fig. 7.—Low stock report.

Aside from the storeroom proper, the Storekeeper should have charge of all material which is stored outside. Lumber, fuel, and heavy castings are examples of material which comes under this head, and his records should include all of this material, and he should have general supervision over its storage in order that he may more readily determine quantities in stock.



Form 31- B&S 75411   REQUISITION FOR SUPPLIES   No. 7667.

To the Purchasing Agent—   April 17th. 1913. *19*

Please supply the following, required for Stock.

Canadian General Electric Company. *and charge Acct.,*   *W O.*

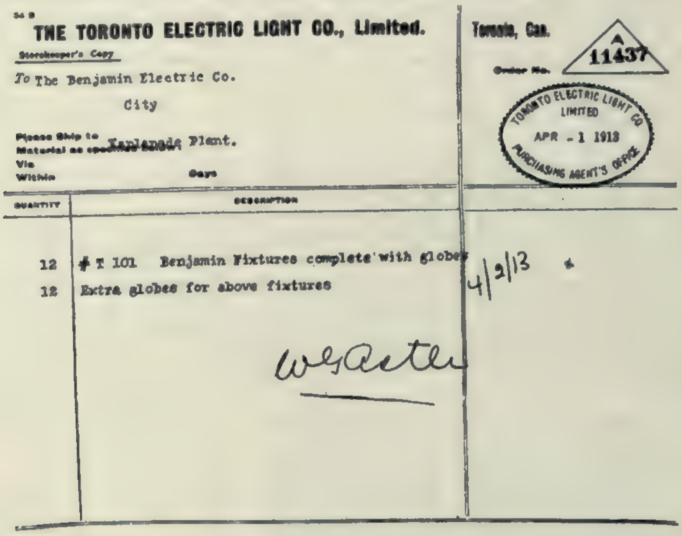
P. Agent's Order No.	Quantity	Description	For use of Purchasing Dep't
	25	Only #1325 3 Pole Double Throw 30 Amp. 600 Volt Fused Motor Starting Switches.	
	Please	rush.	

Storekeeper

Fig. 8.—Requisition from storekeeper.

Stock Records

The purpose of a stock record system is to account properly for all material purchased and used; but the location of the storeroom, its relation to the department served, and the ability and experience of the Storekeeper, may necessitate certain changes in details to meet local conditions. A theoretical system may be outlined which will afford a perfect record, but, when put into practice, it may prove unsatisfactory, or it may be too expensive for the protection afforded. A practical test is always advisable before a decision is made upon a stock record system for any business. The installation of a stock record system calls for the exercise of judgment of the highest order, for the record of sock, material or supplies, is of no less importance than the record of cash, and should be accounted for with the same fidelity as cash. A dollar's worth of material should be registered as a dollar in gold.



THE TORONTO ELECTRIC LIGHT CO., Limited.

Storekeeper's Copy

Toronto, Can.

Order No. A 11437

TORONTO ELECTRIC LIGHT CO. LIMITED APR - 1 1913 PURCHASING AGENT'S OFFICE

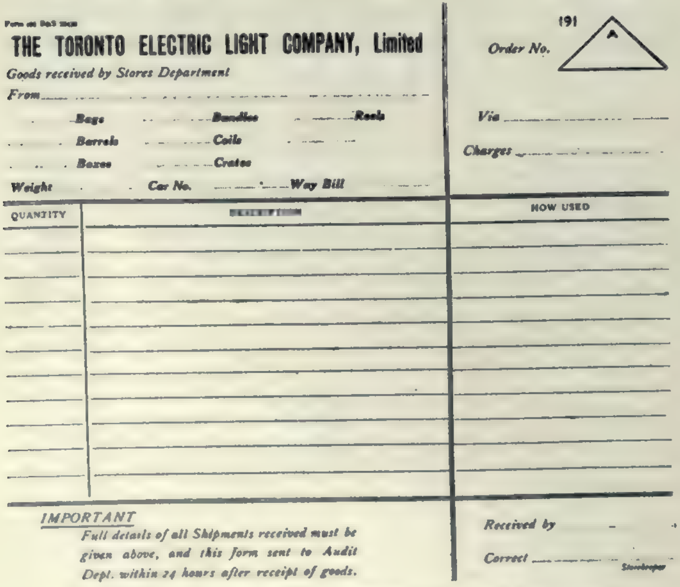
To The Benjamin Electric Co.
City

Please Ship to Material as specified below: Esplanade Plant.
Via
Within Days

QUANTITY	DESCRIPTION	
12	# T 101 Benjamin Fixtures complete with globes	4/2/13
12	Extra globes for above fixtures	

Fig. 9.—Storekeeper's copy of purchase order.

Stock sheets, Figs. 5 and 6, or cards filled topically (or numerically if a symbol system is used) should be kept for each article in stock, and should show the unit, full description, location in the storeroom, normal stock and minimum stock; date, requisition number and quantity ordered; purchase number and name of the firm from whom purchased, dates and quantities received, and the dates and quantities given out, from which a record every day can be obtained of the quantities on hand and quantities on order.



THE TORONTO ELECTRIC LIGHT COMPANY, Limited

Goods received by Stores Department

From

Bags *Bundles* *Reels*
Barrels *Coils*
Boxes *Crates*
Weight *Car No.* *Way Bill*

191

Order No. A

Via

Charges

QUANTITY	DESCRIPTION	HOW USED

IMPORTANT

Full details of all Shipments received must be given above, and this form sent to Audit Dept. within 24 hours after receipt of goods.

Received by

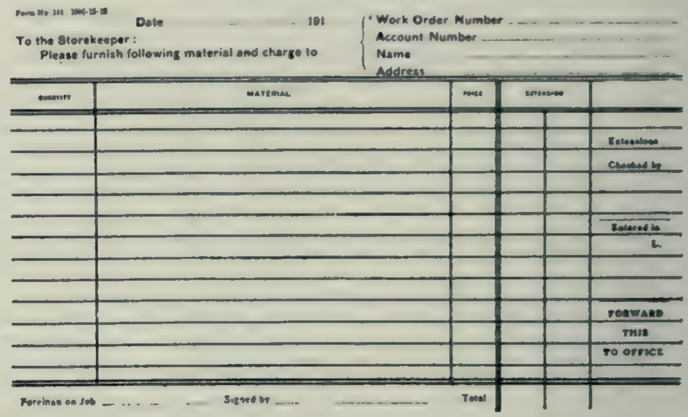
Correct Storekeeper

Fig. 10. - Receiving report—Storekeeper to auditor's department.

Low stock report forms should be kept in the bins so that the stock clerk removing material is automatically notified that more should be ordered when the minimum quantity is reached.

Ordering Material for Stock

Every article of material should be given a low limit, and when this limit is reached, the stock record clerks should make out a Low Stock Report, Fig. 7, to the Storekeeper. This in turn should be verified by the storeroom foreman, and is recognized as a notice to order more. The report should show the low limit and the quantity in stock. The low limit should always be given, for in some instances it is found advisable to change the limit. Material formerly used in large quantities may be found to be in so little demand that it will be necessary to reduce the limit. At other times it might be found advisable to increase the limit. Before replenishing his supply of any material, the Storekeeper should consult the head of the department using the material to determine if any change in the specification will be made. Failure to do this sometimes causes the storeroom to become overstocked with obsolete material or material that has become useless on account of changes on standards adopted. When obsolete material accumulates it should be sold, as it seldom improves with age.



Date 191

To the Storekeeper:
Please furnish following material and charge to

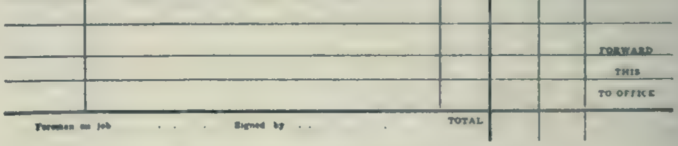
Work Order Number
Account Number
Name
Address

QUANTITY	MATERIAL	PRICE	EXTENSION	
				Extensions
				Checked by
				Entered in
				L.
				FORWARD
				THIS
				TO OFFICE

Foreman on Job Signed by Total

Fig. 11.—Requisition form, when material is withdrawn.

All orders for material should be made on a requisition form similar to the one shown in the illustration, Fig. 8. These requisitions should be made in duplicate, one copy being forwarded to the Purchasing Agent, the duplicate being retained by the Storekeeper, and held for the Storekeeper's copy of the purchase order, Fig. 9, after which they should be filed away under the name of the firm with whom the order is placed, to await deliveries.



Date 191

To the Storekeeper:
Please receive the following material and credit to

Work Order Number
Account Number
Name
Address

QUANTITY	MATERIAL	PRICE	EXTENSION	
				Extensions
				Checked by
				Entered in
				L.
				FORWARD
				THIS
				TO OFFICE

Foreman on job Signed by TOTAL

Fig. 12.—Credit form, when material is returned.

Receiving Material Into the Storeroom

The Receiving Clerk should have charge of all materials received in the storeroom; he should unpack, make proper preservation of packing material and lumber for future use, check over entire receipt in detail. Under no circumstances should the consignor's invoice be given to the Receiving Clerk to check from, as this too often leads to check marks on the invoice without a count of the material. His memorandum of receipt, Fig. 10, should contain an account of all items and statements, and should be compared with consignor's invoice in the main office entirely independent of him. This method insures absolute certainty regarding the correctness of the amount and quality of the materials received.

After each order has been completed, all papers, from the requisition to the receiving report, which pertain to the order, should be collected, fastened together, and filed away under the order number, while a record should be kept of all order numbers showing the names of the firm on whom the orders were placed.

Disbursements of Material

No material should be drawn from the storeroom except on a requisition properly signed and approved by the foremen of the different departments, and all material issued and not used should be returned to the storeroom and the proper credit given. Requisitions, Fig. 11, on which material is given out, should show the use to which it will be put, and the name of the operating expense or other account chargeable. They should all be numbered consecutively, the original being sent to the Accounting Department, and the duplicate retained by the Storekeeper for making the necessary records on the stock records, after which they should be filed under the account chargeable. Materials returned to the storeroom should be accompanied by a credit slip, Fig. 12. This form should go through the same routine as the requisitions or charge slips.

Handling of Scrap Materials

The handling of second-hand material and scrap is very important, and unless a proper record is taken of all second-hand and scrap material as soon as it begins to accumulate considerable loss will result. All scrap should be collected and stored promptly, and as soon as it accumulates it should be sold, as it is very seldom that old material improves with age, and while fluctuations in the price of metals may warrant the holding of some material for a short time, it is not desirable to keep it indefinitely in the hope that prices will go up.

General Observations

Some may think that an elaborate system of stock records requires too much work and provides too many records, but shortages in material are just as expensive as shortages in cash, and there is no reason why one should not be safe-guarded as much as the other. Managers of some factories jealously guard the cash collected daily, which amounts to a few thousand dollars, and it is placed in a bank promptly; even petty-cash accounts must balance to the cent. Let them exchange their cash for material and, beyond checking bills, interest often flags. The Storeroom of any well-organized plant is deserving of the attention and study of every live manager, since much money may be saved by the operating on an efficient basis of this branch of the plant. It is better to have a few extra records and protection than to omit these records and take chances of shortages. In a corporate business, it is the small items which must be closely watched to insure the accomplishment of the greater and bigger tasks which follow business development. Things that seem trivial to the average employee really mean a great deal in the long run if abuses occur, and the old adage, "A stitch in times saves nine," applies very appropriately to the safe-guarding of storeroom materials.

No steel reinforcement should be painted or oiled. Some engineers have required that all reinforcement be dipped in a bath of cement grout before being installed in the forms, but by careful manipulation during the placing of the concrete this extra handling and cost are unnecessary and may be done away with.

The new steel conduit now being completed for augmenting the water supply of Atlantic City is being used as an effective advertising medium. For about a mile the pipe parallels the line of the Pennsylvania Railroad, and, being entirely above ground, makes an excellent signboard. The Chamber of Commerce has painted large signs on it at intervals of about 300 ft., extolling the advantages of the city as a summer resort. The scheme is effective, for travellers follow the successive signs with much interest.

The United States army engineers have long used the following mixture for water-proofing cement: One part of cement, two parts of sand, three-quarters of a pound of dry powdered alum to each cubic foot of sand. These are mixed and dried and to them is added water in which has been dissolved three-quarters of a pound of soap to each gallon. This, it is said, is nearly as strong as ordinary cement, and is quite impervious to water, and does not effloresce. For a wash, a mixture of one pound of lye and two pounds of alum in two gallons of water is often used.

Segregation (separating the stone from the finer material) must be avoided in depositing concrete through chutes. On account of the velocity which the larger stones attain in passing down the chute, they generally fall some distance in front of its mouth, whereas the mortar, sliding gently down, drops vertically from the mouth, thus counteracting to a great extent the labor bestowed in carefully mixing the ingredients. This will necessitate remixing the concrete immediately after it reaches the bottom of the chute; but no time must be lost either in the original mixing or in the depositing, if this second mixing is to do any good.

Bending reinforcing rods is accomplished very simply and satisfactorily at Balboa by an arrangement somewhat similar to the rail-bending machine. The rods are bent by the thrust of the piston-rod of an engine cylinder while the rods are held in place on a table in front of the cylinder. The table is a steel plate bored with numerous holes, wherein are placed moveable steel pegs for limiting the bending. Two such equipments are in use; one includes a single 10-in. cylinder recovered from an old French locomotive. This outfit places a single crimp in three or four ¾-in. rods simultaneously. The second equipment employs two 14-in. cylinders taken from the dumping mechanism of a 2 cubic yard concrete mixer, which are mounted on opposite sides of the table, and make opposite bends in rods as large as 1¼-in. in diameter. In both cases compressed air is used at a pressure of about 80 lbs. per square inch. It is claimed that five men in one hour can bend as many rods as they formerly did in eight hours.

Deep Water Concreting Through a Tube

Notes on the Tremie Method and Suggestions of Various Expedients to Avoid the Difficulties Likely to be Encountered

By E. B. Van De Greyn

SOME time ago in a short article on a method of starting deep-water concreting through a tube it was stated that, "as is well known, unless the tube is sealed in some way the cement will wash out during the downward passage and leave only a pile of stone and sand. This waste of concrete may in the case of a 12-in. tube 30 ft. long amount to more than 1 cu. yd."

It is plain that if the tube is filled by dumping little batches (such as wheelbarrow loads) the concrete in each small batch will be washed until the water in the tube is absorbed or forced out at the top. If, however, a large batch of concrete, sufficient to fill a considerable length of the pipe, say 30 or 40 ft., is dumped at one time into the hopper of the tremie I would not expect the concrete to be washed as stated above—that is, if the procedure of charging outlined hereafter is followed.

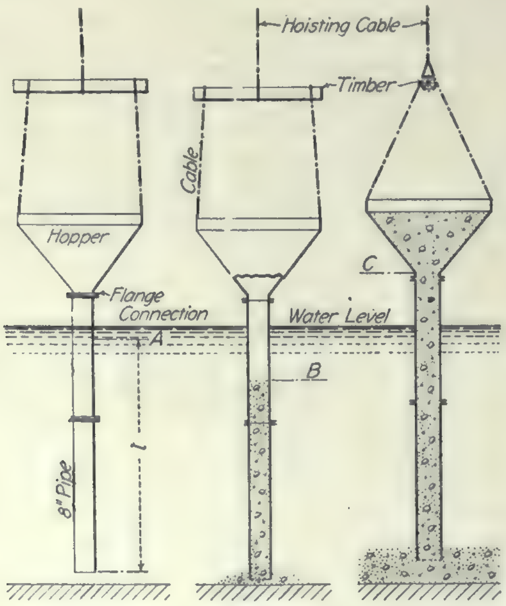


Fig. 1 Fig. 2 Fig. 3

Tremie empty, sealed and ready to be shipped.

Experimental Tremie

A laboratory experiment with a miniature tremie was tried by the writer. The tremie consisted of a glass tube 1 in. in inside diameter and 12 in. long and a tin funnel cut to fit the top. A china plate was placed in the bottom of a water bucket partly filled with water. The glass tube was clamped to a standard with its lower end 5 inches below the water surface and 3/8 in. above the china plate. A batch of mortar was made up of 1 part of cement and 2 parts of standard Ottawa sand, the mortar being made quite wet so as to flow freely through the tube. The batch of mortar was dropped into the hopper several times with the same results. In each case the water was driven out of the tube ahead of the mortar and the mortar spread out over the plate and filled the lower part of the tube. In each case there was no washing out of cement. The mortar extended about 5 in. up in the tube. A depth of water of 5 in. is small compared with 40 or 50 ft., but the experiment shows what might be expected.

Sealing the Pipe

There is no doubt that preliminary sealing of the pipe in some way is the safe way to proceed to charge the pipe for the first time. Under certain conditions of concreting under water I would consider that a layer of shavings and sawdust with a layer of cement on top should be placed in the pipe before starting the concrete, but in some instances the plug might be dispensed with. For example, consider the conditions on one job under the writer's charge. A large open caisson had been sunk to a depth of about 50 ft. below water level in alluvial soil, the caisson had been dredged out and piles driven within, and finally the soil that was forced up during driving had been removed. The excavation was carried a little lower than depth required on the plans. The concrete placed immediately on the bottom would mix with the mud and form a base for the remaining concrete required on the plans, and due to the large mass of concrete to be placed in the caisson it was not necessary often to change the position of the tremie in a horizontal direction. Under such conditions I believe charging the tremie according to the method outlined below was ample protection against washing out of the cement.

The following method of deep-water concreting has been used under the charge of the writer: Inspection after pumping out the water has always revealed the top concrete to be first class. The method and equipment, together with precautions to be observed, are submitted with the hope that some of the ideas may be of benefit to those who may find themselves for the first time in charge of such work.

A tremie is shown in Figs. 1, 2 and 3 made up of sections of water pipe with bolted flange connections and a metal hopper large enough to hold one batch of concrete. The hopper is bolted to the top section of the pipe. All connections are made water-tight by means of gaskets. An 8-in. pipe has proved practicable and has the advantage over larger pipe in being lighter. The view shows a tremie used on the city waterway bridge at Tacoma, Wash. The International Contract Company was the contractor, Waddell & Harrington were the consulting engineers representing the city and the writer was resident engineer for Waddell & Harrington. The same tremie was used on the Puyallup River bridge at Tacoma.

On one job the tremie was raised and lowered with the hammer line of the pile driver stationed on falsework over the caisson. This proved very satisfactory, as the up-and-down movement of the tremie was under perfect control, and such control is important in tremie work. On another job the tremie was suspended from the load line of a barge derrick. This proved serviceable, but not so satisfactory as the pile driver because of swaying of the tremie due to wave action on the barge, and due to tipping of the barge at the time of raising the tremie.

In charging the tremie a large batch capable of filling a considerable length of the pipe should be discharged into the hopper at one time. At Tacoma the concrete was discharged from the mixer into a concrete bucket and the concrete bucket swung over the hopper of the tremie by a derrick. Where the contractor is not equipped with a derrick a contractor's concrete cart holding a large enough batch could be used, or if wheelbarrows are used a hopper with a trap door would serve the purpose of discharging a large batch suddenly into the tremie hopper. After the pipe is once sealed the concrete from then on can be dumped into tremies in large or small batches.

Concrete Should be Mushy

Concrete deposited in deep water through a pipe should be of a mushy consistency in order that it may flow easily after leaving the end of the pipe under the surface of concrete just previously deposited; it will then spread more evenly after leaving the pipe, thus avoiding the formation of hillocks and making it unnecessary to change the position of the tremie in a horizontal direction as frequently as would be the case if drier concrete were used. Also, it will not choke the pipe. A little experimenting at the outset will soon indicate how much water should be used in each batch. After the proper amount is determined it should be regulated by a gauge so as not to vary, consideration being given, of course, to appreciable changes in the amount of moisture in the aggregate.

Mushy concrete deposited in water should have an excess of cement. There is a loss of cement due to the excess water in the concrete finding its way out, carrying a portion of the cement, which is found in the laitance on top. A 1:2:3 mix is recommended; this is the mix specified by Waddell & Harrington for mass concrete deposited under water through a pipe.

Operation

In the illustration Fig. 1 shows the tremie ready to receive the first batch, the bottom of the pipe being raised from 6 to 12 in. above the bottom of the excavation, so that the water may escape as the concrete comes down the pipe. It is well to land the pipe on the bottom and then raise it so that one is assured that it is above the bottom. Assume that one batch would fill the pipe for a length l, that is, when the concrete begins to emerge from the end of the pipe the top surface is at level A. If the pipe is to have a plug of planer shavings and cement they should be in place before dumping concrete into the pipe. Charging the pipe is the most difficult part of deep-water concreting through a tube, hence it should be supervised by some competent person. If the pipe is dropped before concrete emerges from the lower end the water in the lower part of the pipe cannot escape and it boils up through the concrete, washing out the cement. Whether a new charge or the absorption of this water by additional drier concrete is better must be determined by judgment, and the amount of such water should decide which will result in the lesser waste. If the dropping of the pipe in making the first charge is delayed too long all the concrete escapes, which means that one batch is partly lost and the operation must be repeated. After the batch is dumped into the hopper, when the surface of the concrete drops to level A, the tremie should be dropped. By the time the pipe is dropped to the bottom the surface of the concrete will be below level A, as indicated in Fig. 2, and the tremie will be sealed.

After the pipe is sealed with concrete as shown in Fig. 2 the remainder of the pipe and hopper can be filled as shown in Fig. 3. Next the tremie should be raised slowly until the concrete flows downward. It is not safe to raise the pipe continuously until the concrete begins to flow, because by the time the "stop" signal is obeyed the pipe will have been raised too far and there will be a sudden rush of concrete through the pipe, with accompanying danger that the pipe will not be lowered quickly enough to prevent all concrete from leaving the pipe and leaving it unsealed. Therefore the tremie should be raised a few inches and held, and then raised again a few inches and held, repeating until the correct vertical position is found where downward movement will begin; the concrete will then slowly lower in the pipe and will emerge from the bottom under right conditions. All this can generally be done in short time and will cause no delay at the mixer, especially after the men become familiar with the work. When the surface of the concrete lowers to some level, say C, at which it is desired to stop the flow, the tremie is lowered and the flow ceases. There is some definite point at which the pressure on the end of the pipe due to head of water and concrete outside of the pipe plus the resistance of the concrete to move through the pipe is equal to the weight of the concrete. It is to locate this point that the tremie should be raised a little at a time as described in the foregoing. Concrete can thus continue to be placed under water without passing through water, avoiding all wash, emerging as it does from the pipe under the surface of the concrete just previously placed. It is well never to let the surface of the concrete go below the bottom of the hopper, since it is then always in sight; if it is allowed to go below this the next batch confines the air in the tube, most of the air bubbling up through the concrete.

Precautions

See that all connections are watertight. Lash the several sections of the pipe together with cable so as to be able to save them if they break loose. Examine the connections whenever possible to see that they are not broken. If a connection were broken and the break large enough to let concrete through great damage would result by concrete flowing through the break and dropping through the water, causing segregation of the constituent materials. After starting concreting keep it up continuously until completion and regulate the moving of the tremie horizontally so as to keep the laitance on top where it can be removed later. After the water is pumped out, clean the surface of the concrete thoroughly so as to remove all laitance and furnish a good surface on which to start other concrete work.

There appeared recently an instructive article by R. C. Miller on the tremie method of concreting in deep water in connection with building the new Pennsylvania bridge over the Maumee River at Toledo. In view of the similarities and differences in experience on that job and work done under the writer's direction a discussion of some of the methods used at Toledo may be of value.

As described by Mr. Miller, there was used on the experimental pier a 14-in. tremie with a ½-yd. receiving hopper, the hopper being fed from a 15-in. delivery pipe leading from another receiving hopper, which in turn was fed by a ¾-yd. bucket from the 1-yd. mixer. It was stated that the pipe, when filled with concrete, would not free itself until the end had been pulled nearly out of the concrete previously deposited and that when it did start it went with a rush, the quick release of the load at the instant of starting causing the derrick boat to fall back from its tipped position and lift the pipe clear of the concrete, with resultant loss of the charge and filling of the pipe with water. Also, in attempting to "drown out" or absorb the water in the pipe the concrete overflowed the hopper and backed up in the delivery pipe. Later a 20-in. tremie pipe with a 1-yd. hopper was used and the difficulties, though not entirely overcome, were greatly decreased, the laitance deposit being reduced to 2 or 3 in.

Eight-Inch Pipe Ample

In the first case—that is, where the 14-in. pipe was used—it occurs to the writer that the difficulties were occasioned by the following things: First, since this kind of work has been done successfully with an 8-in. pipe lack of sufficient water in the concrete will probably explain why the concrete would not flow until the end of the pipe was pulled nearly out of the concrete previously deposited. A dry concrete would flow with difficulty through the pipe, and the concrete previously deposited, being also not wet enough, would require more applied force to cause it to be displaced, thus adding to the difficulty. Second, in raising the pipe with the barge derrick it was probably not raised a little at a time as recommended above, so that the tremie was not properly controlled in its vertical movements. Third, when the charge was lost and the pipe filled with water it appears from Mr. Miller's article that effort was made to free the pipe of water by pouring concrete into it and not by charging it with a large batch suddenly dropped into the hopper. This seems to be borne out by the description of the equipment, which showed a 15-in. delivery pipe feeding the concrete into the tremie hopper. Pouring concrete into the pipe when filled with water would cause a washing of the concrete and a separation of the constituent materials. Also, when the concrete overflowed the hopper it caused a loss of concrete and added to the amount of laitance deposit.

Disadvantages of Large Pipe

The use of a large pipe, 20-in., for example, occasions certain difficulties. It is hard to handle, and trouble is also found in charging such a pipe the first time. Assume that a 1-yd. batch is used. Such a batch would fill about 12½ lin. ft. of a 20-in. pipe. Where the water is deep the surface of this plug of concrete would be at a considerable depth when its lower end emerged from the bottom of the pipe, and the pipe would then have to be dropped very quickly or the plug would leave the pipe entirely and let it refill with water. With a 12-in. pipe the plug would be about 34 ft. long and the time at which the pipe should be dropped could be better judged, since the surface of the concrete plug would be nearer the hopper and more time would be allowed for dropping it. Thus it is seen that so far as charging is concerned, assuming that the concrete is of right consistency, the smaller pipe is less liable to loss of charge and is under better control.

The major part of the laitance deposit on the Toledo work appeared to be due to spilling of concrete and washing of concrete when it emerged from the end of the tremie as it was lifted clear of the concrete previously deposited. Such laitance should form a comparatively small part of the total laitance formed.

The recommendations of Mr. Miller as to the use of several tremies which would not need to be moved horizontally but only vertically and would be under absolute control as to vertical movement should unquestionably be followed where possible. If such a method is used the quantity of laitance will be due mainly to that formed by the upward movement of the excess water in the concrete through the concrete deposited, such water carrying to the surface the very fine material.

Dilution and Sewage Treatment

A GIVEN sum of money can, in general, be spent to the greater sanitary advantage of communities by the purification of water supplies rather than by the treatment of sewage. There are a great many arguments that may be given in support of this statement, but the important ones are so simple and so well known and convincing that there is no need of repeating them here. This statement cannot be taken to exclude sewage treatment altogether, as there are, of course, many cases where large expenditures for this are entirely justified; and it may perhaps be said, too, that there are only a few places where some expenditure for sewage treatment could not be made with advantage. It would seem as though the field of sewage treatment included the prevention of local nuisance and of excessive pollution, but not, if the economic side be considered, the protection of surface-water supplies from small amounts of pollution.

A view now generally accepted looks upon dilution as an entirely reasonable and safe method of disposal so long as the dilution is great enough to prevent local nuisance. Undoubtedly dilution is a great natural resource for the disposal of sewage and other wastes, and there is every reason for making use of it so long as this use does not result in a menace to the public health, or to reasonable standards of cleanliness. Quite a number of the States have undertaken to control these matters, and their policies are generally in line with the reasonable stand that economy must be considered as well as public health and cleanliness. There may be many States where the density of population is not great, in which no special control is likely to be exercised for a long time to come, as there is no particular need of it.

The need of some such control, or at least some understanding between the two Governments, has during the last few years been realized in regard to the pollution of certain of the boundary waters between the United States and Canada. An International Joint Commission has been at work during the last few years making an investigation of the pollution of the Great Lakes and connecting waters with a view to bringing about such an understanding. The commission has made extensive investigations of the bacteriological condition of the boundary waters at various important points and has done much other work that will be of great value in arriving at an understanding.

The question of standards of water purification and sewage treatment came up before the commission some time ago, and the importance of the question was deemed great enough to warrant the commission in seeking the advice of a number of prominent sanitary engineers. A list of questions was submitted to them and considered and discussed at length. As a result a report was presented to the International Joint Commission giving, in the view of these engineers, the most reasonable answers that they could subscribe to for the various questions. This statement is of importance to engineers and others interested in sanitary questions, as it is the most comprehensive and complete statement of general policy on this subject that has been presented on this side of the water, and takes fully into account the economical side of the question as well as the interests of the public health.

There was one dissenter who objected to certain of the paragraphs and who declined to sign the statement so long as those paragraphs were included. The grounds for his objections seemed to be, in substance, that those paragraphs provided for too generous a use of the natural resources of dilution, required too little in the way of sewage treatment where only moderate pollution was involved, and gave substantial weight to the question of reasonable economy. The dissenter appears to belong to the group—among which many members of the medical fraternity are most ardent advocates—who hold the view, with some disregard for economy, that all sewage and wastes should be treated. As an idealistic view this is most excellent, but it is rare that a community, in taking up the consideration of a question of this sort, does not have to give painstaking consideration to the cost. The lack of approval of this one member does not, therefore, lessen the force and value of the statements of the board of sanitary engineers.

The statements are all pertinent and valuable, but certain points expressed or implied appear to be of primary and unusual importance. They can be briefly stated as follows:

1. In general, all surface water to be used for public supply should be purified.
2. A step is taken toward the establishment of a policy intended to prevent the discharge into boundary waters of any sewage without at least a simple treatment, such as sedimentation or screening.
3. The adequate dilution of a sewage is a highly satisfactory means of disposal, and utilizes an important and economical natural resource.
4. The settling of the suspended matters by gravity in suitably designed tanks, or even the efficient screening of the sewage, is recognized as an important fundamental treatment.
5. The propriety of considering reasonable economy in the working out of such problems as these is established.

While the deliberations of the commission refer specifically to matters connected with the pollution of international boundary waters, the statements of the board of engineers may in a large way be applied to all bodies of water where sanitary questions are involved. The statements commend themselves to all who have to deal with questions of public health and public cleanliness.—Engineering Record.

All forms should have ample strength to support properly the loads they are called upon to carry. Loads on forms should be restricted to those for which the forms are designed. These loads should comprise the weight of the concrete and such necessary construction loads as the weight of workmen, runways, wheelbarrows, etc. Storage of construction materials for future use on the forms should not be permitted under any circumstances.

Limitations of Commercial Engineering

In a broad sense all engineering is commercial in character, but colloquially commercial engineering embraces that branch of the profession which is associated with the marketing of industrial products along technical lines. A striking development has taken place in this field during the last twenty years, and in innumerable instances purchasers of equipment and builders of plants have come to rely upon the advice of commercial engineers in carrying forward their enterprises. The limitations of commercial engineering, however, are often serious handicaps to the fullest success of industrial projects. Seldom have they been so well set forth as in a paper by Andrews Allen upon "Engineering Opportunities in Coal Mining," recently presented before the Western Society of Engineers. The author's conclusions are of general application.

When development or construction work is handled in connection with industrial plants by so-called engineering manufacturers under the supervision of the owner on the "free engineering-service" basis, the combination does not, as a rule, tend toward a broad and comprehensive foresight covering future development or even toward a well-balanced and mechanically efficient installation. In most cases recourse to an independent engineer tends to increase the output and life of the plant, to provide an installation more closely adapted to the requirements as a whole, to insure more economical operation, reduced fixed charges and better satisfaction per dollar expended. Given the required competence, it makes little difference whether the engineer in charge is a salaried employee of the owner or in independent professional practice. The manufacturer is enabled to give better service when he is relieved of general responsibility and can devote himself to doing his work under definite conditions and intelligent direction.

Independent engineering conserves the value of the product by superior preparation and elastic arrangement, taking into account all the elements which make up the plant, through powers of broad analysis and constructive reasoning which the commercial engineer, working in a more limited field, rarely is able to exercise. In much commercial engineering economic waste exists. A manufacturing plant makes its profit by efficient production, and to stay in business it must ultimately establish a selling basis in fair ratio to the cost of its goods. Where such concerns employ a high-priced engineering organization to furnish services for which they are not directly paid, not only is the result essentially unfair—for the customer pays for the engineering expense of from three to ten others—but the manufacturing efficiency of the establishment is often reduced, because so much of the energy of its best men is diverted from the perfection of product and processes. The tendency in such cases to adhere to existing designs, patterns, machine tools and dies militates against well-rounded solutions of the owner's problems.

Plenty of work exists for the engineering departments of manufacturing companies in designing the separate units required by plants and systems, improving such equipment and reducing its cost. When such engineers do general or special engineering work they should make a direct charge for it and thus relieve the manufacturing departments of the burden and play fair with all the concern's customers. Engineers have too long been content to allow their compensation to be covered up in the cost of bill goods, and this is one reason why the profession is so frequently underpaid and unrecognized. Wherever special designs have to be made, where the installation involves the assembly of numerous elements to furnish which the manufacturer would, in fact, be a jobber, or wherever the installation requires careful examination and analysis of conditions and elaborate study of plans, the best results can be secured by an independent engineer directly in the pay of the owner. On the other hand, where a machine, using the word in a broad sense, is manufactured complete by an engineering organization, and where its duties are so definitely known that they can be made subject to definite guarantees under prescribed conditions, and where the engineering work is primarily an adaptation of standards, the design may safely be made by the manufacturer, though even here the independent engineer can be of great help to the owner.

The independent engineer has the best possible opportunity to design his work so as to confine competition within the limits of the plans and specifications. Where competitive general designs are made by manufacturing companies, conscientious firms frequently lose out to those who skin down the requirements and build only just well enough to secure their pay. Where an installation planned by an engineering manufacturer seems to cost less it is usually because less attention has been paid to operating efficiency, maintenance and future requirements. A dollar spent in the beginning is frequently worth ten dollars afterward. If an owner attempts to obtain the advantages of competition without complete plans and specifications, asking manufacturers to prepare their own plans on the basis of general requirements only, the result is usually bewildering. Few bidders are willing to gamble to the extent of making thorough studies and complete designs and the result is a lot of half-baked plans and prices with liberal allowance for uncertainties. Even in cases where the manufacturer is given a free hand and specifically paid for engineering development work in the absence of full plans prepared by the owner or his engineer there is little certainty that the latter will obtain what he most needs. Complications over responsibility often arise, and in such cases the commercial engineer cannot serve the owner with anything like the efficiency of the consulting or staff expert, who in the long run is the best reliance of the investor in matters of broad technical importance.—Engineering Record.

Examination of Concrete Failures for their Determinating Causes

A paper on the above subject read by R. S. Greenman at the recent annual meeting of the American Society for Testing Materials, states that concrete is said to be its own best inspector, and it is a well-known fact that defects in concrete will sooner or later make their presence known.

The reasons for poor concrete have been proportioned as being 90 per cent due to poor workmanship, 8 per cent. due to poor aggregates, and 2 per cent. due to poor cement. These reasons and the additional one of the influence of the water used, are responsible for most of the failures in concrete. These failures are more frequent in smaller than in larger work and the resulting losses are proportionately greater.

To find a reason one must examine all possible causes and must follow up all clues that tend toward disclosing the reason. The design, the quality and proportions of the materials used, the mixing and placing and the care of the finished concrete must all be considered. In making an examination, each case must be treated entirely upon its own individuality; and the right clue will not be found unless the investigator knows good and poor concrete and knows why certain things produce certain results in concrete.

In trying to solve a problem of poor concrete the elements to be investigated are cement, aggregates, workmanship—and water. The common tendency is first to place the blame upon the cement, but if it is found that, in accordance with good and generally common practice, the cement has been tested and has met the standard requirements, the cement then becomes a negligible factor; but if it has not been tested, it must be considered as a possible cause, and it may become a large item in the study. It must be admitted that since so much stress has been laid upon the value of having cement tested before use, and since it must indeed be a small work on which it has not been so tested, the percentage of failures due to poor cement has been reduced to a very small amount.

The strong and weak points in both the coarse and fine aggregates have been too often neglected. The coarse aggregates can usually be judged by easy inspections, but sand or other fine aggregates need very careful examination. Their characteristics—such as the grain, the grading, the cleanness and freedom from organic impurities and excess of loam are items of knowledge which are obtainable mainly in the laboratory, but which are very essential for the correct diagnosis of a concrete failure.

The effect of workmanship is by far the largest factor and in it all others are included, for a poor workman can destroy the value of the best materials. Under the head of workmanship must be considered such items as design, proportions, placing, and actions resulting from heat frost, electrolysis, etc., which should have been taken care of in the process of making, hardening and preservation.

As another element of importance, it must always be kept in mind that the water which is used in making the concrete, or which may come in contact with it, may prove to be a very influential factor for harmful results.

To illustrate the possibilities of various influences, specific cases are cited showing effects of certain elements upon water, sand and stone and the resulting effects upon the concrete. The effects of poor workmanship are seen in various conditions found in concrete. To find these effects it is also necessary that the investigator shall know how to grasp and to follow up the first indications of there having been anything wrong.

Some external influences also cause concrete to fail and the possible relation of these to concrete failures must be considered. For many years all the failures of concrete were considered as being due to the formation of certain chemical relations; but as it is commonly acknowledged at present that an impermeable concrete will stand in sea water as well as elsewhere, although subjected frequently to more severe actions than other concrete, its failures are due frequently to the same causes as those of other concretes and therefore the same examinations should give the same results. Similarly, since electrolysis is considered as a cause for the breaking down of concrete, the liability of concrete being affected by its influence will depend upon whether or not the concrete comes under the influence of an electric current. If it does, then its influence needs to be examined. If it does not, then the axamination should also follow the usual method.

The value of laboratory tests and analyses should not be overlooked. While perhaps not giving such definite information as a field inspection, they should be used to the fullest extent to help establish the strength or weakness of a reasonable theory for the cause of failure. Where time will permit, laboratory tests of concrete made of the aggregates under as nearly as possible the same conditions, will give results that should aid in determining the fault in the original. Test specimens so made and treated should give practically the same results, and when compared with test specimens made under ideal conditions or with standard materials, should give the investigator the reasons for the failure.

All means possible should be used by an investigator in making his examination, and his conclusions must be drawn only after he has considered the failure from every probable cause, with reason and fairness. The object of the examination is either to place responsibility or to guard against future failures, and right conclusions are the only ones that should be drawn if justice to either objective is to be given.

Architectural Terra Cotta

THERE is no older manufactured material known to man, but it is only in comparatively recent years that burned clay, in the perfected form of architectural terra cotta, has come into great prominence as a building material. The favor which it now finds among architects and builders is due in part to certain remarkable qualities which were long latent and undiscovered and which the demands of modern construction have brought to light; and in part to new qualities which have been added as a result of scientific investigation and experimentation with terra cotta in an effort to develop its full possibilities. Because of these unusual natural and acquired qualities and attributes, there is at present available to architects no material which merits more careful attention and consideration than architectural terra cotta. It is without doubt the ideal building material of the twentieth century.

Architectural terra cotta deserves the marked recognition which it is now receiving, first of all, because it is durable. The figurines of Tanagra and the water-jars of Egypt are in practically as good condition to-day as they were when made, thousands of years ago. Architectural terra cotta never wears out. There is, in fact, nothing about it that can wear out. It is as permanent as earth because it is earth. To the two forces that work most potently for the destruction of a building material, that is, fire and water, architectural terra cotta offers the most stubborn and successful resistance. It is manufactured under a terrific heat, more terrific than that of any conflagration. The appalling disasters at Baltimore and San Francisco proved that those buildings in which the structural materials are protected by architectural terra cotta and brick can most successfully withstand the ravages of fire. By water, the other of the two foes of permanence in a building material, architectural terra cotta is totally unaffected. In the case of many materials, water finds its way through the surface, freezes, causes expansion and ultimate disintegration. In the case of architectural terra cotta, this destructive process cannot even begin, because the first step, the penetration of water beneath the surface, is impossible, inasmuch as architectural terra cotta is impervious to moisture.

Architectural terra cotta is further excellently adapted to modern building construction because it is at once strong and light. Ordinarily, these two qualities are inconsistent: the material that is strong is heavy; and that which is light is weak and of uncertain resistance. The modern skyscraper demands a material so strong that it can be used with safety under the most exacting requirements, and so light that the cost of foundations, superstructure, and installation may be reduced to a minimum. Architectural terra cotta is just such a material, and its use for the entire facing of the largest business buildings in the world is an evidence that wide recognition is being given to its unique qualities.

Every architect to-day is alive to the demands of beauty and attractiveness. Even in buildings designed for the most utilitarian purpose—in factories, for example—there is a strong demand that the aesthetic sense be satisfied. Architectural terra cotta, because of its infinite possibilities as regards form, may be modelled to express the most delicate beauty and charm. It can be made in many tints and colors and in limitless combinations of colors. And, what is equally important, it retains all of its original qualities. Dirt, smoke and soot do not permanently discolor its surface; they do no damage that cannot be easily undone by the application to the terra cotta of ordinary soap and water.

Architectural terra cotta, while it possesses these remarkable qualities, offers unusual opportunity for economy. This material makes it possible for the finest ornament to be used in buildings intended for the most practical purposes, at a most reasonable cost. For years, fine ornament was divorced from modern utilitarian architecture because it could be secured only by the slow process of individual hand carving. By fine ornament is not meant the disgusting amount of cheap, machine-made ornaments that disfigure rather than embellish, but those legitimate forms that have had the endorsement of all ages. When the cost of hand carving became prohibitive, these had to be abandoned. Now by the use of architectural terra cotta—by making a plaster mold of one piece and pressing many pieces from the same mold—the sculptor's model for cornice, pediment, or frieze can be duplicated at relatively low cost. This process of repetition is such a decided saving that it makes feasible the employment of the best available talent for the creation of the original model. As a result, the most pleasing effects can be introduced without waste and with the utmost economy.

Consider the practical advantages that result from the use of a material with these extraordinary qualities. Because of its lightness of weight, it is easily and inexpensively handled and put in place; and because of this same lightness, it makes possible a substantial saving in connection with the entire structure. Once placed in position, it is durable for all time. It cannot melt, disintegrate, or decay. It can, moreover, in the first instance, be made unusually attractive and beautiful by the use of a great variety of surface finishes or of one or more colors, and this original beauty is permanently retained. It is fire-proof, waterproof, dirt-proof and time-proof. It is, in short, all that could be demanded by the most exacting and discriminating in the way of an ideal material for use in the buildings of the twentieth century.

The Selection of Asphaltic Materials for Road Construction

THE fundamental requirements of asphaltic materials are discussed in a concise and interesting manner in the following paper, which is a prize essay submitted by A. A. Berkowitz in a recent competition held by the Barber Asphalt Company.

To specify an asphalt by its chemical or its physical properties alone is not enough. The chemical properties of two asphalts might be the same, while physically they differed markedly. Moreover, a relationship exists among certain properties, and there is danger of assigning limitations to the several properties covered in a given specification without considering the effect of each limitation upon the other properties included. For instance, the higher the ductility required of an asphalt the more susceptible it is to change in temperature. Furthermore, the engineer cannot be governed entirely by theoretical considerations, but must keep in mind the ability of the manufacturers to meet his requirements. He should avoid making requirements that are superfluous, inconsistent, unnecessarily increase the cost, or sometimes even impossible to carry out. Numerous instances can be cited where the combinations of properties required have not existed in any commercial material. These impossible requirements usually result when the engineer selects clauses here and there from several other specifications which he knows to have given satisfaction. With a view toward remedying this evil, the American Society of Civil Engineers, the American Society for Testing Materials, etc., have prepared standard specifications for asphaltic materials in various kinds of road construction. These specifications are very well drawn up and serve their purpose admirably, provided they are correctly and intelligently used. It is in this regard that experience can help us. In cases where these specifications have been used, nearly all the failures have been due to the fact that the specifications were followed blindly, without an understanding of their value and their interpretation; merely, as it were, substituting in a formula without considering the units involved. A knowledge of the value and interpretation of each test must be possessed by every engineer who makes or who uses specifications before he can hope to obtain success in the employment of these very desirable materials. This is, in fact, the chief lesson of experience. Then, knowing these facts, and keeping in mind the lessons of service tests of similar materials under similar conditions, the engineer can employ specifications with the assurance that his work will be a success.

The value and interpretation of the more important tests required of asphaltic materials will be discussed. The method of actually making these tests will not be taken up, since these can better be obtained from the aforementioned standard specifications.

The individual tests usually specified may be divided into three groups: (1) They may directly indicate the suitability of the material specified for a given use; (2) they may serve as a means of identifying the material or its source, and (3) they may serve to control uniformity in the preparation or manufacture of a material.

Viscosity.—The most important test belonging to the first group is the determination of the consistency or viscosity. The consistency or viscosity of a material is its degree of firmness as determined by measuring its internal friction. Requiring this test in the specifications is of value since a physical test can generally be better understood than any corresponding chemical one. This test, however, can be of maximum value only when applied to a specific type of asphaltic material and when considered in connection with other tests, which by themselves may not directly indicate suitability. Thus for one type of bituminous concrete pavement the proper penetration at 25 deg. C. for a California asphalt may be between 7 and 9 mm., while the proper penetration limits for a fluxed Bermudez asphalt, to be used in exactly the same type of pavement and under the same conditions, may be from 14 to 16 mm. Again, experience has shown that a harder asphalt cement is needed for a sheet asphalt pavement of sand, powdered limestone, and asphalt cement, than for a pavement containing crushed stone. The amount of traffic and the climate are also important factors to be considered in fixing penetration limits for any asphaltic material.

Volatilization.—Another test serving to indicate the suitability of a material for any special purpose is the volatilization test. A determination is made of the loss in weight of the material by volatilization, and of the consistency of the residue. It is of considerable value when applied to road oils. The loss in weight thus found is a fair indication of the loss by volatilization suffered by the material in the course of time when applied to the road, and also the character of the residue is similar to that eventually left in the road. The residue should be of a sticky nature. If the residue of these oils are not sticky and adhesive they will produce an undesirable surface in wet weather. A paraffin oil will produce a greasy residue, and is consequently worthless for road work, whereas an asphaltic oil may be successfully used for this purpose.

Identification Tests.—The more important tests serving as a means of identifying the source of a material or even the material itself, are the specific gravity, melting point, solubility, in carbon disulphide, and fixed carbon determinations. The specific gravity of an asphaltic material is one of the most important characteristics used to determine its identity. This is especially true if its specific gravity is considered in connection with the consistency of the material, and sometimes its solubility in carbon disulphide. Thus a bituminous material with a specific gravity of 0.99 and a penetration of 7 mm. at 25 deg. C. is a blown product. Fluid consistency and a high specific gravity of 1.25 in a tar serves to identify it as a coal tar, and the identity is strengthened if its solubility in carbon disulphide is as low as 75 per cent. As applied to oil and oil products, the specific gravity roughly indicates the amount of heavy hydro-carbons which give body to the material. As a rule, paraffin oils have the lowest specific gravity and are of no value for road work, whereas asphaltic oils have the highest specific gravity and are most desirable for this purpose. In regard to solid bitumens as originally found, it must be remembered that the specific gravity will depend largely upon the per cent of mineral matter. Thus the specific gravity of Trinidad asphalt (containing 37 per cent of mineral matter is 1.40, while Gilsonite, an extreme-pure native bitumen, has specific gravity of 1.04.

The melting point of a bitumen is directly related to its hardness and brittlemess, but the relations for all clasess are not the same. The method of employing the material must also be considered in connection with its melting point. If the penetration method is used, the melting point should not be too high, because the highly heated material would be solidified by the cold stone before it had penetrated to any extent. In a bituminous concrete pavement, the melting point may be as high as climatic conditions will allow.

The determination of the solubility in carbon disulphide of an asphaltic material enables the amount and character of the contained bitumen to be ascertained. The percentage of bitumen thus obtained does not alone determine the value of an asphalt for paving purposes. Two asphalts might contain the same amounts of bitumen and yet possess entirely different powers of resistance to the destructive action of the elements. One might possess stability, the other not. The character of the bitumen does, however, indicate, by the amount of mineral matter present, whether an asphalt has has been used. Likewise, an absence of mineral matter indicates that the material has been destructively distilled during its preparation.

The amount of fixed carbon in asphaltic material also serves to identify the source of a material. Thus high fixed carbon in most asphaltic cements produced from Mexican petroleums serves to differentiate them from asphalt cements of the same consistency produced from California petroleums. Consequently, if the amount of fixed carbon found in a California asphalt cement were as high as the amount usually present in Mexican asphalts (about 16 per cent.), the indication would be that it has been injured by overheating.

Method of Manufacture Tests.—The tests that serve to control the preparation and manufacture of a bituminous material are the flash point, distillation, and the solubility in naphtha tests. The temperature at which the material flashes is an indication of the treatment to which it has been subjected. Crude oils have a low flash point, while more highly distilled products have correspondingly higher flash points. The flash point of a material must be considered in connection with its proposed use. If the material, especially a heavy road oil, is to be heated before application, the flash point should be high enough to prevent its ignition while being heated.

The distillation test is a valuable one, indication of the amount of body-forming hydro-carbons which give mechanical stability to the material. No oil containing less than four per cent. of bitumen insoluble in naphtha will prove of service other than as a dust preventative.

Service Tests.—To the valuable data that may be obtained in the manner described above must be added the lessons of experience and service tests of various conditions and in different types of roads and pavements.

The need of alleviating the dust nuisance has involved the use of asphaltic oils for that purpose. Experience has shown that the oils used should show some degree of adhesiveness when rubbed between the fingers. Their residues after the evaporation test should be decidedly sticky. If oily, they will act more as lubricants than as dust binders.

It must be emphasized again that paraffin oils are worthless for this purpose. Engineers throughout the country are finding that the use of palliatives for dust prevention is but a makeshift at the most, and that the best practice is tending toward the construction of bituminous surfaces or carpet coats wherever any degree of satisfaction and permanency is desired.

Bituminous surfaces are used principally on macadam and gravel roads, on bituminous and cement concrete pavements, and to some extent on brick and stone pavements. The character of the traffic to which the road is to be subjected should be considered in the construction of a surface. Experience has shown that if the road is subjected to light motor and light team traffic only, with the motor vehicles predominating, an asphaltic oil of such viscosity that it requires heating to at least 250 deg. F. before application forms a bituminous surface that withstands the traffic and thoroughly preserves the road for a period of time depending upon the quality of the material and workmanship and upon the quantity of traffic. The failure of many bituminous surfaces can be traced to improper preparation of the broken stone surface. The adhesion of the oils to the stone is a very essential point to consider. Most engineers are in favor of applying the bituminous material under pressure since the adhesion to the stone is much more satisfactory in this case. In order to get the best adhesion of asphaltic oils, the stone surface should be a little moist rather than extremely dry, but in either case, every particle of dust and dirt should be removed from the stone by sweeping. With proper construction and under normal traffic conditions, retreatment is necessary every one or two years. In choosing the bituminous material for a surface which will have to be renewed often, experience has shown that care must be taken to select a material which will set up sufficiently to allow the application of repeated layers without producing a plastic, easily moved blanket surface. Properly constructed, bituminous surfaces are quiet, practically dustless, and comfortable to use.

With the advent of the motor car, it was found that the water-bound macadam pavement did not stand the automobile traffic and that bituminous macadam could be laid to withstand this traffic at a cost equal to water-bound macadam, when the maintenance of the latter is considered. The bituminous material used may be either asphaltic cement or refined coal tar. The former is preferable because it possesses greater stability under atmospheric action. Here again, numerous instances can be found where unsuitable materials have been employed through the failure of the engineer to understand the physical and chemical properties of the different types of asphaltic materials, and the different methods of treating them. For example, many a good asphalt has been ruined by overheating. Again, asphalts of too little ductility have been chosen. The slight displacement of the mineral aggregate of a pavement due to the shocks of hoofs or wheels makes it necessary that the asphalt cementing material should yield and stretch a little and not break. On the other hand, the greater the ductility, the more susceptible is the asphaltic material to changes in temperature. Once more the knowledge of the relationship among the various properties of a material enables the engineer to intelligently set the limits in his specifications.

A series of experimental sections was constructed on a road subjected to mixed traffic of about 100 horse drawn vehicles and from 250 to 300 motor cars per day. These sections were constructed with asphalt, refined water gas and coal tars, and combinations of refined coal tars and asphalts, in the form of bituminous concrete pavements, using the same material for the cement and the seal coat. Upon examination after three years, it was found that for this class of traffic, or for horse drawn traffic exclusively, the seal coat should consist of an asphalt, as being more durable and economical than the other materials. Experience in another locality has shown that an excess of flux or of the volatile constituents in asphalt cements has been a cause of failure. Pavements constructed with such materials are wavy and distorted by heavy traffic.

Sheet Asphalt

One of the most widely used pavements is sheet asphalt. Trinidad asphalt was for many years the only available supply of such material, but in recent times many other sources have been disclosed. In addition to the native asphalts, like those obtained from Trinidad and Bermudez, asphalts are obtained by refining asphaltic oils. The results of experience and service tests in this kind of pavement alone furnish the engineer with a collection of valuable data. The selection of both the aggregate and the asphalt cement requires a careful understanding of the climate, traffic and other conditions. Proper drainage, in this, as in all other pavements, is a primary requisite. Furthermore, certain bitumens require more skill in handling than others. Again, some require particular fluxing agents and result in failures when improper ones are used. The main requisite of a good sheet asphalt pavement is inherent stability. This can only be obtained if the mineral aggregate is properly selected and if the bitumen possesses cementing value. Experience has shown that the heavier the traffic to which the pavement will be subjected, the finer must be the particles composing the mineral aggregate. In addition, the consistency of the asphalt cement must be of the right degree, that is, the newly laid pavement should not be too hard. The marking up of a pavement by the caulks on horses' shoes does not necessarily indicate that the pavement has been improperly constructed. If the pavement were too hard at the start it would have a shorter life than if a softer asphalt cement had been used. Sheet asphalt pavements properly constructed with native asphalts, either from Trinidad or Bermudez, have given the highest degree of satisfaction. The Barber Asphalt Paving Company recently took a census of the old asphalt pavements. In New York City there are 184,290 sq. yds. of Trinidad sheet asphalt 20 years old or older. A part of this is on Fifth Avenue and is subjected to the very heaviest traffic. The remainder is also subjected to heavy travel, yet all the pavements are in very good condition at the present time. Washington, D.C., has more than 1,000,000 sq. yds. of Trinidad sheet asphalt pavement laid between 1877 and 1901. The average cost of maintenance is 1.8c per square yard per year.

Notes on the Causes of Failure of Stucco Work

NOT many years ago stucco was quite generally used in certain localities, but owing to failures of the material to withstand the action of the elements and to other causes, this type of construction was almost entirely abandoned, says a writer in Cement and Engineering News. During the last few years, however, there has been a very marked tendency by the building public to take up this class of construction again; therefore this word of caution.

We do not want to have the same experience with this class of work as the concrete block industry has had, and yet, unless due care is used in drawing specifications and in their application, there are going to be a great many failures as in the past. Our architectural friends are very partial to stucco exterior, and if it is properly mixed and applied, will come up to their expectations in every way. So much depends on the selection of the material, proper mixing and proper application that only skilled mechanics who are familiar with this class of work should be employed.

I remember one residence in particular, where there were a great many horizontal cracks in the stucco running almost the entire length of one side of the building. These cracks were about two feet apart and were very pronounced. The whole area of sides and ends was very unsightly. After a careful investigation it was found that in nearly every instance where cracks had developed, they were at a point where the wire lath was lapped, and in many places less than one-quarter inch thickness of stucco was over these laps. In some instances by cutting out the cracks it was found that the metal lath was not even tacked solidly in place, and yet stucco work in general was condemned by a number of parties on the results obtained in this one building. It was quite apparent that the trouble was not due to any fault of the material, but in this particular instance was entirely due to the application of the wire lath and stucco. In addition to the large cracks at the laps of the wire lath, there were a number of hair cracks throughout the entire area, which apparently were caused by too much trowelling of the concrete mass, and as was found by investigation there was a coating or frosting of Portland cement on some of the areas and the cracks penetrated just through this frosting. Other areas were entirely smooth and cracks had not developed.

In another case regular lime mortar plaster without any Portland cement was used for the scratch coat. The first coat consisted of regular interior plaster and the second coat consisted of Portland cement, asbestos rock and asbestos fibre. The second coat was very thin and the damp salt air and moisture penetrated through to the first coat. The lath became swollen and the stucco came off in sheets. The stucco on this work was condemned and the faults were laid at the door of the asbestos and Portland cement. Upon investigating the matter thoroughly, it was readily shown that the entire trouble was due to the nature of the lath and the materials entering into the first coat.

I have referred to these buildings with a view of cautioning people interested in stucco construction to see that this particular part of the building is given proper attention. In the past stucco has been applied in two coats, the total thickness being about one-half inch to five-eighths inch. Past experience is teaching us, however, that one inch is by far better, and if the the material is applied in this thickness house owners and architects should not have reason to regret its use.

To Obtain a Uniform Color

Another point of considerable importance is the color. A uniform color is rather difficult to obtain, on smooth surfaces particularly, but it can be obtained if proper attention is given to the selection and mixing of the ingredients and if the stucco is properly applied. When Portland cement and sand are used, it is very essential that the sand should be absolutely free from any organic materials which have a tendency to discolor. It is also of vast importance that the ingredients be mixed very accurately and carefully and that a sufficient amount be mixed at one time to cover certain areas exposed to the same lights and shadows.

For example, the work should not be left in an uncompleted condition half way between windows or half way down the side walls, for just as surely as this is done, there will be a streak showing where the latter work was started. If it is necessary to do a certain given area at two operations, care should be used to get the materials properly blended and the new stucco floated or trowelled to correspond exactly to that already done. By using a little care on details of this kind the ultimate results will be much more satisfactory.

Improper Mixing

Portland cement and sand as a stucco mixture has been used with fair success where work has been carefully supervised, but there has been such a lack of proper attention to the mixing and application that there have been some bad failures. The use of asbestos rock and fibre to take the place of sand is meeting with considerable success. The asbestos fibres have a tendency to hold the water which is used to mix the concrete mass, longer, thus giving the Portland cement ample opportunity to become properly set, and in this way stucco mixtures are possible that are more uniform in color and less liable to crack, as the fibre also furnishes additional bond.

There is one point which is frequently lost sight of; that is, it is possible to manufacture or make concrete slabs that are free from cracks and that can be exposed to the elements for an indefinite period without discoloration. Therefore, should cracks develop in a well-constructed stucco work it can be invariably traced to settling of the building or the shrinking of the frame. By insisting upon thicker stucco walls the liability of the stucco's cracking is reduced to a minimum.

The price of lumber is readily advancing and the desire for fireproof exteriors, especially in the suburban districts, as well as artistic effects that may be obtained from stucco, are creating a universal demand for this type of construction, and, while the initial cost may be slightly more, it is such a small part of the total outlay and such an important part of the structure that the best is the cheapest in the end.

Mainly Constructional

East and West—From Coast to Coast

EASTERN CANADA

Hamilton ratepayers have defeated a bylaw to spend $175,000 on the construction of a sewerage system.

The Montreal General Contractors' Association have new permanent offices at Victoria Building, Victoria Square.

Tenders have just been taken by the architects (Messrs. Audet & Charbonneau, of Montreal) for an apartment house estimated to cost $275,000, to be erected at Westmount, Que.

The new school building which is being erected at Quebec by the R. C. School Commissioners at a cost of $200,000, is nearing completion. The architect is Mr. R. P. Lemay and the general contractors Messrs. Jinchereau & Lalonde, Quebec.

Constructional operations at the west end disposal plant which is now being erected for the city of Hamilton, are progressing satisfactorily, according to the City Engineer, Mr. A. F. Macallum. It is expected that the plant will be ready for service by November.

Plans are in preparation by Mr. J. H. McDowell, a local architect, for a new theatre estimated to cost $200,000, to be erected at the corner of St. Catherines and Mountain streets, Montreal. Mr. Maurice Wolff, of Montreal, is among those interested in the project.

Excavation is in progress for an apartment house, estimated to cost $100,000, to be erected at Bay and Herkimer Streets, Hamilton. The building will be 125 ft. by 65 ft. in dimensions, six storeys high, of fireproof construction. The architects are Messrs. Stewart & Witton.

The season's operations in road work in Northern Ontario are practically at an end. Excellent progress has been made and the total expended has reached $850,000. The work has been carried out under the direction of the Government Commissioner, Mr. J. F. Whitson.

Tenders are about to be called for a $200,000 club house which the National Amateur Athletic Association propose to erect at Montreal. The new building will be 4½ storeys high, 110 feet by 106 feet in dimensions. The architects are Messrs. J. A. Ouellet and J. O. Turgeon, both of Montreal.

Foundation work on the Earnscliffe Apartments has been started at Toronto. The new building, which is estimated to cost $500,000, will be eight storeys high, of steel and brick construction. The architect is Mr. N. G. Beggs, and the general contractors are Messrs. Deeth & Son, Toronto.

Preliminary arrangements have been completed for the construction of a large office building and garage for the Automobile Club of Canada, Montreal. The provisional plans are for a ten-storey building. The time of commencing operations depends to some extent upon the course of the European war.

A gratifying statement covering the first year of operation to June 30, 1914, has been issued by the Ontario Steel Products Company, Limited. The net profits are over $106,000. These have been determined for the year after providing for depreciation of properties and the entire cost of organization.

Good progress has been made in the erection of the six-storey, reinforced concrete factory building which the Ford Motor Company are building at Toronto. The walls are now up five floors and operations are continuing. The general contractors are Messrs. F. J. Mark Construction Company, Birmingham, Ala.

An addition estimated to cost $300,000 is to be built at the Ford Motor Company's plant at Ford City, Ont. The new building will be 200 feet square, six storeys high, of reinforced concrete construction. The company is now building assembling factories in Toronto and Montreal, and they expect to start another in London, Ont., by the fall.

A start has been made on the office building which is to be erected at the corner of Adelaide and Toronto streets, by the Excelsior Life Association, at a cost of $500,000. The structure will be eleven storeys high, of steel, terra cotta, and brick construction. The architect is Mr. E. J. Lennox, and the general contractors are the P. Lyall Construction Company.

The foundation work for the Assembly Hall which St. Patrick's Parish propose to erect at Montreal has been completed. The general contractors on the new building are Messrs. John Quinlan & Company. The type of construction will be reinforced concrete and steel, and the estimated cost is $135,000. Mr. J. P. Hynes, of Montreal, is the architect.

Plans have been completed for the dry dock and shipping plant which it is proposed to build at Owen Sound at a cost of $1,500,000. The promoter of the project is Mr. F. F. Wood, and the architect and engineer is Mr. E. D. Pitt, both of Niagara Falls, Ont. Major Gillette, of Philadelphia, is the consulting engineer. The proposed dock will be 775 feet long and 104 feet wide, with a depth of 21 feet.

The City Engineer of Montreal, Mr. George Janin, has submitted to the Board of Control the report of the experts appointed some time ago to examine the conduit. The report states that the construction of a second conduit is not necessary. The sum of $25,000 is said to be required for repair work on the present conduit. It is expected that the enlargement of the aqueduct will be finished within two years.

The exterior structure of the new post office now under construction at Quebec, at a cost of $400,000, has been completed. The building is to be six storeys high and the materials entering into its construction are Deschambault stone, marble, terra cotta, hollow tile, reinforced concrete, and steel. All the most modern equipment will be installed. The accessories include ventilators, fire escapes, iron railings and stairs, revolving doors, mail chutes, telephone system, sprinklers and motors.

The harbor development work at Toronto is to be carried on in accordance with the plans laid out at the beginning of the season, according to a statement made by the Secretary, Mr. A. C. Lewis. This year the Harbor Board will spend approximately $1,400,000 on reclamation work, piledriving, piers, and the excavation of the ship canal in Ashbridge's Bay. About one thousand men are employed on the works. Half of these are in the employ of the Commission. The rest are engaged by the contractors.

The ratepayers of St. Catharines, Ont., have carried a by-law to construct a high level bridge across the old Welland canal from the main section of the city at Shipman's Gore to Western Hill, where the G. T. R. main line, Niagara Falls to Sarnia, is situated. The viaduct steel structure, with approaches, will be constructed at an estimated cost of $220,000. The project has been under discussion for over a quarter of a century, and the other proposed routes have been previously voted down. The new bridge will connect the main automobile road between Buffalo and Toronto on the west side of the old canal, with the main business street of the city.

WESTERN CANADA

At Dauntless, Alta., excavating has commenced for the $750,000 factory which is to be erected by the Dominion Harvester Company.

At Regina, Sask., the Parsons Construction and Engineering Company have obtained a contract for a power house, six residences, and other work in connection with the provincial gaol.

The drill hall which is being erected at Winnipeg for the Dominion Government, at a cost of some $500,000, has reached the roofing stage. Excellent progress has been made by the general contractors, Messrs. Carter-Halls & Aldinger, of Winnipeg.

Steel work has been completed on the Grain Exchange building which is being erected at Winnipeg by the Traders Building Association at a cost of $500,000. The building will be of brick, stone and steel construction. Messrs. Jordan & Over, Winnipeg, are the architects and Messrs. Carter-Halls & Aldinger the general contractors.

At Calgary, operations have commenced on the erection of a new building for the Merchants Bank of Canada. The new bank, which is being completed this year, is three storeys high, of steel and brick construction, with Bedford stone and granite front. The architects are Messrs. Brown & Vallance, and the general contractors are Messrs. Carter-Halls & Aldinger Company, Winnipeg.

At Edmonton, Alta., excavating has started on the offices and apartments which are to be erected at the corner of Jasper and 16th Streets by Hugh McPhee at a cost of $100,000. The building is to be four storeys high, of reinforced concrete, steel and brick construction. The architect is Mr. E. W. Moorehouse, and the general contractors are Messrs. Nesbitt & Miller, both of Edmonton.

Foundation work has been started on the new central school which is to be erected at North Vancouver, B.C., at a cost of $120,000. Contracts for the actual building have not yet been awarded. The new school will have two storeys and basement and will be of reinforced concrete, tile, and brick construction. The architect is Mr. W. C. Gillam, and the general contractors are Messrs. W. J. Smith, Limited, both local firms.

Estimates for work completed on the Greater Winnipeg Water District railway, diversion dike, and other parts of the undertaking were passed last week, the total amount involved being about $200,000. Chief among the items were $61,000 for steel rails to the Algoma Steel Corporation; $45,000 for railway construction to the Northern Construction Company; $48,000 to O'Brien & McDougall for ties. The district has now secured 74 per cent. of the ties needed, and 55 per cent. of the steel rails. Of the telephone line 71 miles are now complete, and on the railway construction 36 per cent. of the excavation is done, and 20 per cent. of the total of 94 miles of track laid, while 71 per cent. of the railway splice bars are already delivered. Up to July 25 grading had been completed on 40 per cent. of the line, and 20 per cent. had been ballasted. The whole of the right of way for the railway and aqueduct has been cleared, thus completing that part of the work involving the clearing of 2,583 acres. The district has purchased 14,467 fence posts. At Deacon the reservoir site, the contract for the boring of the well has been about completed, and the well now being finished is capable of delivering 40,000 gallons a day. On the Falcon River Diversion dike, the contractors drew an estimate of $13,000 for work done, the part of the whole dike completed being 36 per cent.

At Newton, Ont., a contractor named Davidson fell from a scaffold last week and succumbed to his injuries.

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Alphabetical Index of Advertisers
Page 18

Vol. 28 September 2, 1914 No. 35

Principal Contents

Page
Economy of Adequate Information to Tenderers .. 1093
A Municipal Engineering Corps 1093
Business Facts About the War 1094
Engineering Topics in the Old Land 1095-6
Special London, Eng., Correspondence
An Example of Successful City Planning in Germany 1096-7
The New Royal Bank Building, Toronto 1098-1100
By J. B. Carswell, B.Sc., A.M. Inst. C. E.
Applied Geology in Municipal Engineering 1100-3
By Herbert Lackworth, D.Sc., M. Inst. C., E.
The First Unit of Vancouver and Districts' Great Sewerage Scheme 1104-6
Staff Article
Experiments in Sewage Treatment 1106
The Selection of Pavements for Roads and Streets 1107-8
By W. H. Connell
An Unsupported Pavement 1109
By H. H. Macdonald
Curtailment of Water Waste and Selection of Meters at Milwaukee Water-Works 1110-1
The City-Manager Plan of Municipal Government 1112-3
By P. E. Kressly
A Public Comfort Station with a New Feature 1114
Paint on Cement or Concrete Surfaces 1114-5
Typical Specifications for the Wiring of Residences 1115-9
Personal Mention—featuring Messrs. J. B. Carswell, A. D. Creer and R. W. Brock 1119-20
Constructional News 1121-2
Coming Events 1122
Business Notes 1122

Economy of Adequate Information to Tenderers

Of the many interesting features in connection with the undertaking of the Vancouver and District Joint Sewerage and Drainage Board described in this issue, none is more noteworthy than the completeness of the form of contract and specification. We have had to voice so many complaints about the inadequateness of the information given to tenderers upon such works as this that we take peculiar pleasure in paying this tribute.

It is fair to assume that the comprehensive details given by the Engineer were largely responsible for the close and satisfactory bidding. Nine tenders in all were received. Of these, eight ranged between $396,000 and $333,000, while the lowest and successful one was $309,000.

The Form of Contract, Specification, Schedule of Quantities and Tender are neatly bound in a permanent form, and, to facilitate reference, the contents are carefully indexed. Every detail and every requirement of the work are described thoroughly with a completeness and lack of ambiguity quite refreshing. The schedule of quantities is prefaced by underlined admonitions to contractors setting forth the points of governing importance. Emphasis is given to the definition of terms and the methods of measurement employed, while a special instruction covers the itemizing and totalling of the tender.

A specification of this kind might be taken as a text for more extended criticism, but it is sufficient, perhaps, herein to draw attention solely to the desirability and ultimate economy of sparing neither time nor trouble in the preparation of information for tenderers. It is of particular value to the authority awarding the contract, as it ensures close bidding and places a premium upon careful figuring.

On the face of it, tenders for the work in question might well have varied considerably more than they did, and the Engineer to the Board, Mr. A. D. Creer, is deserving of commendation for the successful results obtained.

A Municipal Engineering Corps

Those of our civil engineering readers whose hearts respond quickly to the call of country and Empire will be interested in the suggestion regarding the formation of a municipal engineering corps made by our London, Eng., correspondent in his letter published in this issue. Dozens of men identified with various branches of engineering have responded to the call to arms, but hundreds have remained, and there must be some useful work which the great remnant can perform. It is possible that the scheme is of more vital interest to the "tight little island," from geographical and many other standpoints, but the unexpected turn of events of the last month should lead us to an ampler recognition of the fact that to be forewarned is forearmed.

As the natural resources of Canada are developed, the country becomes more tempting, and it is not beyond the realm of reason that covetous eyes and unholy desires have already been turned towards us. At any rate, the more self-reliance shown by Canada in such a time as the present, the greater and more enduring will be her progress when the peaceful ways of commerce are opened up once more. The idea of a military organization of municipal engineers throughout Canada may bring a smile, but the suggestion comes from old London, emanating from a man of wide experience in various parts of the Empire, and, so far as we are concerned, it is entitled to editorial mention by virtue of its originality. In the Old Country, the suggestion is one which the War Office declined several years ago. At that time, however, it was established pretty clearly that the municipal engineering profession throughout the Empire would give energetic support to the movement.

Our municipal engineering readers may engage themselves with the line of opposition they would offer to a hostile force if the occasion demanded some action.

Canadian civil servants may be interested in the salaries obtained in the various departments of the service in United States. At the time of writing, the current issues of our New York and Chicago contemporaries contain advertisements for a Deputy Commissioner of Public Service at Chicago—salary $4,000; for an Illuminating Engineer at Chicago—salary $1,920-$2,400; for a Foreman of Sewer Cleaning at Chicago—salary $1,600-$1,800; and for a Tunnel Foreman at Chicago—salary $7 a day.

We advise cities not to rashly close down work or postpone projects indefinitely, thus throwing many citizens out of employment, but to act on the assumption that in a very few weeks they can raise money on terms at least as favorable as a year ago and possibly as those of this spring. On the other hand, however, every effort should be made to avoid selling at high rates of interest long term bonds which will commit the city to the payment of such interest for many years to come.—Municipal Journal.

The last issue of the Engineering News contains the advertisement of a civil engineer willing to accept any position suited to his experience. He states that he has had twenty years' experience in railway and general engineering and building construction, that he is forty-five years of age, that he is married, that he is in good health, that he speaks Spanish and English, that he has travelled extensively, and that his average salary has been $12,000. It is to be hoped that this versatile practitioner will not turn to the Canadian field as an outlet for his activities. There are 1,378 Canadian applications on file for the first $12,000 vacancy here.

It is the opinion of Dr. Alfred Thompson, M.P. for the Yukon, that the next great railway to be constructed in Canada with be from a point on the Grand Trunk Pacific in British Columbia through the northern part of the province and the Yukon, connecting with the system which is to be built by the United States Government in Alaska. This will open up a vast territory in Northern British Columbia and the Southern Yukon, and provide railway communication from Sydney, C.B., to the boundary line of the Yukon, making it possible to entrain at Vancouver and ride to the shores of the Behring Sea. This railway project is not considered to be by any means a remote possibility. The opinion is expressed that the plans of the United States to spend thirty-five million dollars in building one thousand miles of railway in Alaska will give an impetus to trade in the Yukon.

Business Facts About the War

WITHIN one month the British people have been able to tell the world that they will go about their business as usual, with the war only as an incident.

Do you realize what that means, you business men of Canada? It means the greatest step forward in British enterprise and trades that has ever been taken. While the manhood of Continental Europe is engaged in war the world will not stand still. The men who will be fighting will number no more millions than can be counted on the two hands. Hundreds of millions of people in all parts of the earth will go about their business as usual. There is trade in abundance to be done.

Continental Europe has been pre-eminently the workshop of the world. Great Britain, Canada and the United States must now do the great part of the world's manufacturing. Not for years will any of the Continental European countries recover from the blows they are dealing each other. Meanwhile we of the English-speaking world will have got a long way ahead in the race.

Apart from the dislocation of trade in other countries, think of what the annihilation of Germany's foreign trade means—and already it is annihilated. The exports from the German Zollverein amount to ten millions of marks per annum. Since Germany has committed trade suicide, somebody must do that business. Canada has a better opportunity than any other country to get her share.

There is another consideration. Agriculture will be more or less paralyzed in Europe for years. Yet the nations must eat. Canada, as one of the great food-producing countries of the world, will have enormous demands made upon her for food. This will mean an impetus in the development of Canada's natural resources.

Happy, happy Canada! Though vitally interested in this war, we are far removed from its theatre. Though shocked by war's horrors, and rocked by its backwash, we stand not to lose, but to gain by it. While effete dynasties are warring to their doom, we, in our untrammelled youth, are called upon to take up our full burden of the everyday work of the world. Wealth and work, industry and commerce, are to be transformed wholesale from the old world to the new.

Don't stay aside, you business men, and look on at the war in helpless awe. Don't draw in your business tentacles, and tighten up your purse-strings. This is not the end for you. It is but the beginning. For Continental Europe this war is a calamity. For Canada it is a tide, which, taken at its flood, leads on to fortune.

Engineering Topics in the Old Land

Proposed Municipal Engineering Corps and its Functions—The Discussion Anent the Fresh Air Inlet and the Intercepting Trap

Special London, Eng., Correspondence of the Contract Record

WITH Europe an armed camp, no apology is needed for harking back to a scheme which, although decisively knocked on the head by the War Department, is yet capable of application in the Old Country and might with advantage be adopted in her overseas Dominions. It was in 1909 that the minds of three geniuses (of which the writer was one) evolved the scheme. For some months it was discussed in all its bearings by the trio, and in September a meeting of municipal engineers was called at the Westminster Palace Hotel, London, at which it was decided "that the municipal engineers present constitute a committee to be known as 'The Municipal Engineers Imperial Defence Committee,' having for its principal object the organization, in connection with the defence of the British Empire, of the members of the municipal engineering and kindred professions and their mechanics and skilled labourers." The honorary secretary was at the same time instructed to write to the War Office and the Board of Agriculture bringing certain facts and suggestions to their notice and asking them to receive a deputation from the Committee.

A Municipal Engineering Corps

Shortly, the scheme was the formation of a municipal engineering corps, to act with the Technical Reserve of the Territorial Force, and the salient points of the "facts and suggestions" were as follows: (1) Every local authority possesses on its staff one or more municipal engineers; (2) these have to design and carry out every description of engineering and other constructional work, including the construction and maintenance of practically the whole of the roads and road bridges throughout the country; (3) power stations, hospitals, waterworks, and sanitary works fall within their duties, as do largely the construction and supervision of docks, harbours, foreshores and seacoast protection works; (4) as regards materials and labour they hold a unique position, controlling large bodies of men and knowing the sources available for the supply of material; (5) they have an intimate knowledge of the topography of their districts, and could maintain or destroy lines of communication, or establish other lines, with the least possible delay; (6) the ordnance survey is ever needing revision, and they could form a current ordnance survey department, recording developments and alterations as they arose; (7) in transport matters their aid would be invaluable. It was estimated that the numerical strength of the corps would approximate to 2,000 technical officers and 25,000 mechanics and skilled labourers, many of whom would already have served in the Army or Navy. "By the creation of this force the whole of the British Isles might be sub-divided into convenient areas, each superintended by a responsible engineering official, whose duties, among others, would be to furnish information of a technical character with regard to the district under his control. The corps would constitute 'A Special Intelligence Department,' embracing the entire country, whose records would readily furnish the minutest details of information of even the most remote and secluded district."

Declined With Thanks

To one paragraph in the letter attaches special interest. "Although the suggestions of the committee have relation to the British Isles only," it ran, "it is felt that the engineers and surveyors to municipal authorities throughout the Empire would be prepared to give loyal, generous and energetic support to the movement. Communications with this end in view are being forwarded to the various Colonial Governments. The question of National Defence has never before been recognized, as it is to-day, as a matter of individual duty; and the committee take this opportunity of assuring you that those municipal engineers and surveyors who have been approached are in enthusiastic agreement with the scheme herein sketched out." It would be wearisome to recapitulate all the attempts that were made by the Committee to obtain at least consideration for the scheme. The Press throughout the country were unanimous in their support, and some of the largest papers devoted special leading articles to it. Every effort was futile, however, and the matter had to die the death when the War Department wrote "to express the thanks of the Army Council for the patriotic spirit which had prompted the Municipal Engineers Imperial Defence Committee to submit the scheme for their consideration," but they were "unable at present to sanction the formation of such a corps as was suggested." It is scarcely necessary perhaps to add that the communications referred to were never sent to the Colonial Governments. The committee had had quite enough of Government Departments to go on with. Looking back upon the scheme, and reading it with the most critical care, it remains, in the writer's opinion, one which should have been adopted without question; indeed the word "sanction" scarcely seems to apply. It may not be too late even now, when the present trouble is over, for the matter to be reconsidered.

Since the last paragraph was penned, attention has been called in many directions to the advisability of doing what was suggested in 1909. "Cannot the municipal engineer," writes one gentleman, "make preparations for the proper safeguarding of the water supply, the lighting, the scavenging, and other municipal services in case of need, so that if, unhappily, the occasion arose, he would not find himself unprepared? Cannot he ascertain if the bridges and roads under his charge are capable of withstanding the strain of troops, baggage wagons, and heavy guns making use of them? Should he not carefully consider how he can assist the military authorities in the selection of temporary camping grounds, and the best methods for the supply of water and the removal of the "waste products" of the men? Would he not be the best person to advise as to the choice of buildings which might be the most convenient for temporary hospitals, in case of need? Would not his local knowledge be of the greatest value in settling these and many other

28(35) 1914

points that might arise?" and so on. But singularly enough communications of this nature refrain from any reference to the work of the original Committee. Happily the Committee is quite prepared to sink its individuality, and to say no more about it if only others in the profession will get a move on.

"An Interesting Discussion"

The writer has read with interest the letter from Mr. Frederick Osborne Smith which appeared in the Contract Record of July 29 (page 966). The point at issue between him and Mr. Smith are the fresh air inlet and the intercepting trap. With the abolition of open gullies to receive wastes the writer agrees. "The abolition of the gullies . . . . is a distinct advantage," he said in his "letter" which appeared in the July 1st issue. "The average gully forms a miniature cesspit and Mr. Smith is right when he says ——" and so on. The writer would have no objection at all to a fresh air inlet if it did admit fresh air. His contention is that an inlet may act just as freely as an outlet, and being fixed at or near ground level is a danger to health. Mr. Smith says the fresh air inlet should be "taken outside and fixed as far as possible from any opening into the house, terminating at least 18 inches above ground." The first two points are essential, but as regards the third 18 feet would be better than 18 inches. That every drain should have two untrapped openings for ventilation purposes is agreed, and all the writer asks is that both of these should be at a fair height above ground, and of course removed from window or other openings. Any reader can test for himself the alternation of currents in both inlet and outlet pipes, by simply holding a lighted match in the opening.

Departmental Reports

"It is therefore natural," writes Mr. Smith, "that little or no attention is paid to the report" (that of the Departmental Committee of the Local Government Board), "as lamented by your correspondent." Mr. Smith has misconstrued the "lament." The writer's point was that engineers are beginning to lose faith in expert committees "and especially in the medical expert committee-man." He deplored the fact simply because "guidance of some sort is necessary in these days of swiftly-changing opinion and the unceasing introduction of new appliances and methods." This is not quite the same thing as lamenting that little or no attention has been paid to a certain report. His regret is that one more cherished delusion of youth should have gone by the board. There was a time when Royal Commissions and Departmental Committees were regarded with reverence and their pronouncements treated with respect. They are but seldom treated seriously now, and the fact is certainly to be deplored. As to the intercepting trap as an adjunct to a house drain, the writer has an open mind, and he inclines to the opinion that no hard-and-fast rule can be laid down. In a town having no interceptors at all none are necessary. In a town with a few, those few may constitute a danger; while in a town with many, the lack of one in the few instances may equally well constitute a danger. The subject is too long for treatment here, however; and really the writer's sole point was that text-books insist on the interceptor merely because other text-books do so. That the authors will not think for themselves is clear, as if they did they could not remain in such perfect accord on such a contentious matter. "Intercepting traps are optional in Ottawa," says Mr. Smith in his paper, and it would be interesting to hear the result of any observations that may have been made there as regards trapping and non-trapping.

An Example of Successful City Planning in Germany

An article on the results of city planning in Essen, Germany, where the famous Krupp Steel Works are located, is an interesting feature of a recent issue of Engineering News. Under the impetus of rapid growth the city of Essen adopted a large and comprehensive street plan and the success which has attended the work has placed it in a leading position in this field. The population of Essen is 325,000, an increase of 172 per cent. over the figures for 1900. In 1910, 92 per cent. of the wage-earners of the city were receiving annual incomes of only $216 to $720, and therefore it was found necessary to include in the housing plans a large number of cheap houses. In the new homes it was thought to combine cheapness, attractiveness and healthfulness. That the problem has been successfully solved is shown by the fact that between 1900 and 1910 the death rate decreased from 25.84 to 12.35 per thousand.

An examination of a map of Essen shows a very complete system of radiating streets leading toward the centre of the city, but as these approach the old section they become almost hopelessly lost, as there are no adequately wide streets cutting across the old part of the city. There are, however, a couple of such streets already planned to relieve the existing conditions. This old section might be described as a series of squares and market places connected by narrow, winding and often hilly streets. It has been found necessary to place one track of the trolley line on Kettwigerstrasse on a back street, and the remaining track runs so close to the sidewalk that a pedestrian cannot safely walk too close to the curb.

The streets at first seem to be hopelessly tangled and crooked, but as soon as their arrangement is studied it becomes apparent that this is a carefully planned disorder.

The whole street system is worked out with the primary aim of a characterization of the streets, and there is probably no other city in which this fundamental German idea has been so completely developed. The aim of the planner was to furnish, throughout the city, constantly new and varied vistas, not only in respect to the houses and their relations to the streets, but also in the width and arrangement of the individual streets. The completeness with which this has been carried out is shown by the fact that the range of vision in the streets is, as a rule, limited to 650 to 1,000 ft. The main traffic streets are often exceptions to this rule, but every opportunity has been taken to avoid monotonous stretches on these.

To one used to the average American city plan, Essen streets are at first very confusing and the short and crooked streets perhaps lose some of their attractiveness when they become solidly built up to the sidewalk line with ordinary houses, and the lack of any long views may give a crowding and oppressive effect. A distinct advantage of the irregular system is the readiness with which large open places can be created at the main inter-sections by the cutting off of sharp corners, and advantage has been taken of this is Essen.

Not only do the streets differ from each other, but in many cases the individual streets are unsymmetrically arranged so as to avoid any chance of monotony. That is, the sidewalk is often a wide promenade on one side and an ordinary sidewalk on the other. Several very attractive streets are arranged with a single line of trees which are placed along a wide and principal footway. Another attractive arrangement is made with three rows of trees by placing the main footway between two of them on one side. Even the stereotyped system with two rows of trees is varied by surrounding one by a grass plot and the other with mosaic stone pavement.

It has been attempted to segregate the residences in small groups each of which shall have its own retail stores. An open market place is also usually provided for each residence section. This plan has been greatly aided by the Krupp Company, which has established throughout the city a series of colonies for its employees. The most interesting of these are Magarethenhohe, a colony for the Krupp officials, and Altenhof, in which the old and decrepit employees are provided with charming homes, each designed for a man and wife. These colonies are among the most attractive parts of Essen.

The system of parks in the new part of the city was laid out with a view of having one of the larger parks within five to ten minutes walk from any section, and this has been practically realized. The total park area is not large, as it was in 1910, only 7.4 per cent. of the total area of the city, or about 104 sq. ft. per inhabitant. Essen is, however, much better off in this respect than this figure indicates, due to the large tracts of woodland just south of the city and along the Ruhr River. This district can be reached in fifty minutes by foot or twenty minutes by trolley from the centre of the city and so is readily accessible and is much frequented by the people of Essen. There were in 1910 46.8 sq. ft. of playgrounds for each child in the city.

Essen is primarily a city of low buildings, and the tendency seems to be for the height to decrease rather than increase. This is in part due to the great chance of damage to high or large buildings due to the settlement of the land over the coal mines by which practically the whole city is undermined. Evidences of this settlement can often be seen in the old walls and buildings. The height of buildings in the city is distributed about as follows:

Four storeys in height—10 per cent. of the total area.

Three storeys in height—26 per cent. of the total area.

One or two storeys in height—54 per cent of the total area.

The group system of buildings has been well developed and has helped greatly to furnish variety in the street fronts. Steep tile roofs are usually used, as giving a more attractive appearance and individuality than the monotonous line of flat roofs prevailing in the solidly built up parts of so many cities.

The results have been obtained with the aid of a strict building ordinance, a liberal land policy and a concentration of power under one head. As in most of the German cities the city is divided into several districts according to the use of the land and the regulations for each district are somewhat different. A summary of the restrictions for maximum height and unbuilt areas follows:

	District 1	2	3	4
Max. height of buildings	18 meters	18 meters	16 meters	16 meters
Unbuilt portion of lot	25% (2 & 3 sto.)	30% (2 sto.)	35% (2 sto.)	40% (2 sto.)
	30% (4 sto.)	35% (3 sto.)	50% (3 sto.)	50% (3 sto.)
		40% (4 sto.)	55% (4 sto.)	60% (4 sto.)

Ordinarily, the height of a building must not exceed the width of the street it fronts upon, although under certain conditions an additional two meters is allowed.

The great detail with which the plans have been worked out can be illustrated by two examples, which are by no means exceptional. In Messelstrasse, one of the houses in a block of three-storey houses was limited to two storeys in height so as to afford from a neighboring street a view of a large and handsome school building. Again, in a plan recently made for an outlying section, arrangements have been made with the evangelical church association to build a large and monumental church at the proposed intersection of five main streets.

The entire plan for the new sections of the city and the modifications of the old plan were designed and are being carried out under the direction of Beigeordneter Dr. R. Schmidt, the chief engineering official of the city of Essen.

Fire insurance requirements with particular reference to fire prevention, as summarized in a pamphlet issued by the New York Chapter of the American Institute of Architects and the New York Board of Fire Underwriters, comprise six important considerations, as follows: (1) Shutters, doors and skylights, outside sprinklers and fire hydrants, to reduce exposure to fire from without; (2) construction of the building to resist for four hours a temperature of 2,000 deg. Fahr.; (3) design of building with limited height and suitable fire stops, lightning protection, wire glass, gravity tanks and proper electric wiring; (4) fire extinguishing equipment; (5) consideration of nature of occupancy, character of contents and class of work, and proper installation of dangerous machines; (6) public fire protection, which depends on the efficiency of municipal fire, water, and building departments.

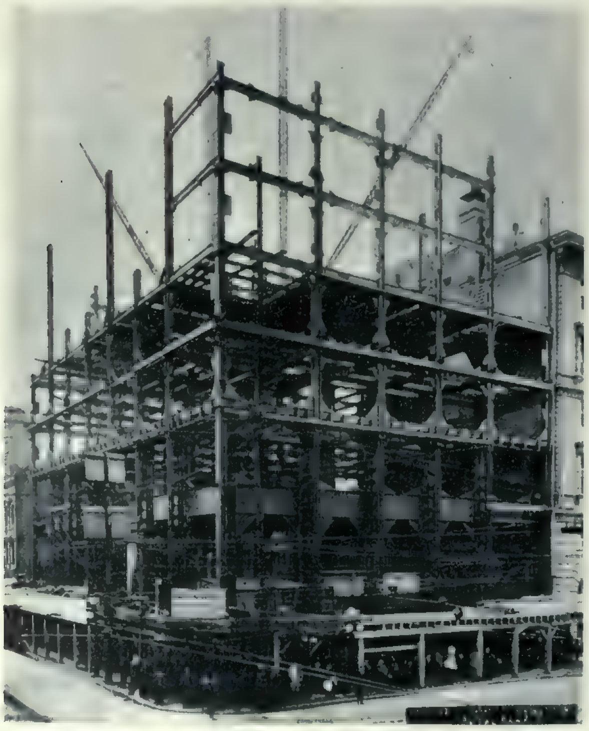
The Hauenstein Tunnel on the Baste-Olten line in Switzerland has been pierced, and, military troubles permitting, will be opened in June next. The tunnel is 5 miles 94 yards in length, and was commenced on February 1, 1912. When completed, it and its approach lines will replace the existing line between Sissach and Olten. On the latter line there is a tunnel 1 mile 968 yards in length, constructed in 1854-8. There is practically no difference between the lengths of the old and the new routes, the reason for the construction of the new line being to secure an easier gradient. On the new route the maximum gradient will be 1 in 95, and in the tunnel the gradient will be 1 in 133 for about 4½ miles, and 1 in 666 for the remaining distance. As a result of the improved gradient, twenty minutes will be taken off the time of the journey between Basle and Olten. The contractors for the new tunnel were the Julius Berger Tiefbau Company, of Berlin, and the price was nearly $4,000,000. The tunnel has been pierced about eighteen months in advance of contract time.

The New Royal Bank Building, Toronto

Progress Report on a Structure which will be the Highest Building of its Class in the British Empire—Interesting Problems in Design and Construction and the Manner of Their Solution

Specially Contributed by J. B. Carswell, B.Sc., A.M. Inst. C.E.

THE new bank and office building now under construction on the northeast corner of King and Yonge Streets, Toronto, has several unique characteristics. Besides occupying a corner site on what is claimed to be the busiest street crossing in Canada, it also has the distinction of being the highest business building yet erected in the British Empire. The height from the sidewalk to the cornice is 255 feet, and above that again is the 20th floor, set back a little from the street line, with the tank-room and machinery pent-house on top of that, giving a total height from the sidewalk of 300 feet. The extreme over-all figure from the bottom of the foundations to the top of the flag-pole is 340 feet.



Royal Bank, May 28, 1914. Showing the heavy wind-bracing details on the King Street elevation.

General Lay-out

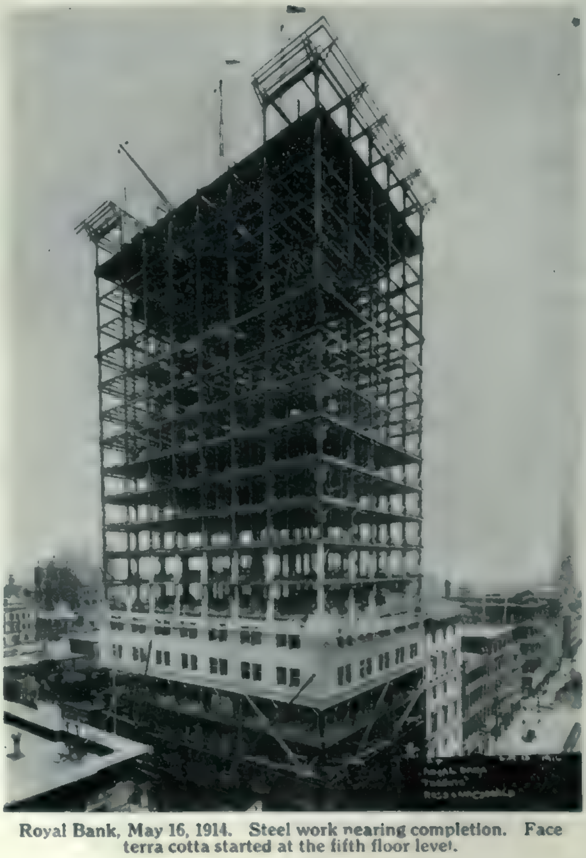
The building is placed on a lot measuring 112 feet by 81 feet and is laid out so that a total rentable area of 6,250 square feet is obtained on the typical floors. This constitutes 69 per cent. of the total area of the lot. In the basement the usual boiler room, with a 20-foot ceiling is provided, also the accompanying engine room and storage room for the tenants above. The ground floor is laid out for four small stores facing on Yonge Street. The floors of these will be about three feet below the sidewalk. On the King Street side the ground floor is occupied by the Savings Bank Department of the Royal Bank of Canada. Above these stores, and occupying the whole of the main or first floor, will be the banking room of the Royal Bank, access to which will be had through two doorways on King Street. The main entrance to the building proper is also from King Street. The large elevator hall, with walls and floor of Botticini marble and ornamented Caen stone ceiling, will be a feature of the building. Two stacks of three elevators will serve the nineteen typical office floors above.

Progress

The excavation for the substructure was started in September, 1913, the steel work proper in February of this year, and the exterior stone and terra cotta in April. The steel work, after the heavy girder work for the first floor was placed, proceeded at the rate of three storeys a week. The whole building was closed in during the last week in June and at the time of writing the plaster work is in a fair way to completion. It is anticipated that the first tenants will move in during the latter part of October.

Description

The forty-four steel columns rest on circular concrete caissons, six to seven feet in diameter, bell-mouthed at the base. These caissons are founded on hard shale. At a depth of 35 feet below the side-



Royal Bank, May 16, 1914. Steel work nearing completion. Face terra cotta started at the fifth floor level.

walk, samples of this shale were procured and subjected to crushing tests by the University of Toronto. It was found that the material stood up to 72 tons per square foot. By bell-mouthing the caissons the actual load on the shale under the most severe conditions is about 15 tons per square foot. It is interesting to note that this bed of shale goes down for some 600 feet before real limestone is found. This same stratum may be seen outcropping at the Don Valley brick yards, three miles or so to the northeast of the site.

Many interesting problems presented themselves when these foundations were being designed. On the east boundary the steel columns butted right up against the party line, but the caissons had to be kept within the limits, the result being that the columns rested out on the circumference of the circular caissons instead of in the centre. This was overcome by introducing heavy steel grillage-girders under these columns and under the adjoining row of interior columns. The exterior wall is therefore cantilevered from the adjoining interior columns—which means that the tenant standing in the elevator hall is helping to sustain the brickwork in the exterior wall!

The caissons are composed of 1:2:4 stone concrete. The hard clay met with was simply cut out like cheese to the required dimensions and the concrete poured. Pockets of water under compression with ignitable gas in suspension were found in the shale but were no real obstruction to progress.

The steel for this structure was rolled partly in Germany and partly in Scotland, and it was fabricated partly in the Montreal shops and partly in the Toronto shops of the Dominion Bridge Company. On account of the height, heavy wind-bracing was necessary. This was carried from the basement to the third floor line by auxiliary columns alongside the columns proper. Above the third floor one column carries both the load and the wind stresses. There are 2,600 tons of steel in the building.

The floors are terra cotta tile arches, with the usual cinder-fill and a cement finish. The two main elevations facing on King and Yonge Streets have a granite base course, large and imposing Corinthian columns of Indiana limestone, with a light cream-colored semi-glazed terra cotta above, forming the main shaft of the building. The rear elevations are of pressed brick, a little darker in shade than the terra cotta. There are 266,000 face brick and 1,164,000 common brick in the job.

The window frames and sash are all of metal, the front elevations having double-hung copper covered windows and the two rear elevations having the regulation fire underwriters' windows.

Royal Bank, July 4, 1914. A view of the rear elevations from the northeast.

Royal Bank, July 25, 1914. View of finished exterior.

The woodwork throughout is a high-grade Phillipine mahogany, known as "Tanguile". The corridors and public spaces have tiled floors with marble base. The interior arrangements are subject entirely to the requirements of the tenants and hardly two floors will be laid out alike when the work is finished. The building is heated by a direct low-pressure system, operated from two 180 h.p. return tubular boilers. The plumbing, ventilating, and electrical work is all being installed in the most up-to-date manner. The elevator installation will also be the finest procurable, consisting of six Otis-Fensom No. 17, direct-connected, electric machines, operating about 700 feet a minute. Power and light will be supplied to the building by the Hydro-Electric Company. The elevators and all other motors will use 250 volt direct current, and the lighting current will be 115-230 volt, alternating, 25 cycles.

Rather an interesting structural change is being carried out at the present moment on the 19th and 20th floors. After the roof was on the building the Toronto Board of Trade made arrangements with the owners to occupy these two top floors. To give the proper accommodation, five columns had to be removed through two floors. Naturally, this threw additional loads on the adjoining columns and these are being reinforced right down to the 11th floor by encasing them solidly with 1:2:4 concrete having a ¾-in. aggregate. At this level the sections of the columns are sufficient to take the extra load. A large assembly room with a 16-foot ceiling height, unobstructed by columns, is thus provided on the 19th floor. The council room, grain room and general offices will also be on this floor, while on the 20th floor above club quarters will be provided. A feature of these quarters will be the balcony (leading off the dining room and lounge room) from which a magnificent view of the lake, the city and the surrounding country can be obtained.

The finished building, exclusive of the site, will cost about one and one-quarter million dollars. It is owned by the Guardian Realty Company, for whom Messrs. J. and L. M. Wood are the managers.

The Geo. A. Fuller Company are the general contractors. Their sub-contractors for the steel work are the Dominion Bridge Company, for the face terra-cotta the Federal Terra Cotta Company, and for the limestone work the E. F. Giberson Company, while the Don Valley Brick Works are supplying all of the brick, floor tile arches and interior terra cotta. The Ebsary Fireproofing Company are erecting the gypsum partitions. R. C. Dancy has the plastering, Jas. Elgar, Inc., the carpentry, and Robt. McKay the painting. The Architectural Bronze and Iron Works are supplying the architectural iron. Messrs. A. B. Ormsby and McFarlane Douglas (conjointly) have the kalamein, roofing and sheet metal work. The elevators are by the Otis-Fensom Company. The heating is in the hands of Baker, Smith & Company. The plumbing is by Wells & Newton and the electrical work by L. K. Comstock & Company, Inc. The marble work is by the Dominion Marble Company and the tiling by the Wm. H. Jackson Company.

The architects for the building are Messrs. Ross & Macdonald, Montreal and Toronto.

Applied Geology in Municipal Engineering[*]

By Herbert Lapworth, D.Sc., M. Inst. C.E.

FEW municipal engineers of to-day can fail, after much experience, to realize the importance of practical geology in the construction of their works. The success of underground water supplies, whether attained by knowledge, trial and error, or by a stroke of luck, is admittedly dependent in each case upon the local geology. In works of sewerage, again, the cost may be largely influenced by the nature of the geological materials met with in the trenches and tunnels, producing, as they may do, difficulties and expense in excavation, timbering, dealing with ground water, and modification in the design and construction of the permanent work. The same general principles apply to all deep excavations or foundations that may be carried out by the municipal engineer, whether in the construction of new roads with deep cuttings, sea, river and retaining walls, bridges, reservoirs, sewage tanks, or large buildings. The geology of building stones, road metals, and similar materials, though in a lesser degree, is of importance in all those branches of municipal work in which they are constantly employed.

One of the most striking factors that has forced applied geology upon the attention of the engineer has been the number of disputes which have arisen between contractors and municipal authorities concerned almost solely with the "nature of the ground" encountered during construction of public works. A few of these cases have been taken to the courts, some to arbitration, while others have been privately settled. In most instances the cause of the dispute has been due to some misunderstanding as to the "nature of the ground," or, in other words, the geology of the excavations, and almost invariably the ultimate result has been costly.

Frequently this kind of trouble has been the result of providing intending contractors with inadequate or misleading descriptions of the strata obtained from trial holes or borings. Another cause has been the enforcing under the contract of a type of construction unsuited to the kind of ground unexpectedly encountered in the trenches or foundations.

Quite outside the question of legal disputes, however, serious difficulties have arisen, and heavy expense has been incurred by locating works in bad ground, either through lack of previous geological investigations, or by wrong deductions from haphazard exploration, when such troubles might have been avoided in the original location or largely anticipated by investigation with practical geological knowledge.

It is a remarkable fact that this branch of engineering, common as it is to all classes of the profession, and on which so much frequently depends, is so strangely ignored in our own engineering literature, and until recently so little considered in the scientific training of civil engineers. Thus, we find in our engineering text-books the most minute mathematical investigations of structures, more or less without relation to the varying geological materials on or in which they may be placed.

As a minor example, retaining walls, the dimensions of which, other things being equal, depend entirely upon the geology, water-bearing nature, and dip of the materials to be supported, are subjected to detailed mathematical analysis which may, in the drawing office, be slavishly applied to practice by arithmetical and graphical calculations, without any knowledge of the ground in which the walls are to be built.

To a limited extent the design of tunnel and sewer sections, for example, in "good" and "bad" ground are considered in text-books, but no account is given of the many types of material met with underground under varying conditions, nor of the principles of the occurrence of underground water, the great variation in cost, and the difficulties of construction under different geological conditions. Under "earthwork" we find the usual tables of slopes, prismoidal formulae, and the like, but practically nothing on the highly important subject of "slips," or treatment of soft, unstable or "bad" ground.

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[*] Paper presented at the recent annual meeting of the Institution of Municipal and County Engineers (Great Britain).

It may be argued, and rightly, that these are matters of actual practice and experience; but this does not excuse the failure of these treatises to impress the student with the great variation in cost and difficulties of engineering construction in different deposits, and the fact that efficiency and economy in construction might be as much the result of geological knowledge and investigation as of skill and experience in calculation and design. In some degree this void in the engineering text-books is due to the extreme complexity and variation in the physical properties of the geological deposits, which render them incapable of mathematical analysis.

Another inconsistency is sometimes to be seen in the letting of large contracts, where we may have items in the schedule of quantities amounting to only a few shillings, yet the contractor may be wholly ignorant of the character of the ground in which the works are to be constructed, and may, in consequence, under-estimate by several thousand pounds the cost of excavation.

The causes which have contributed to the scant consideration of practical geology among engineers are not easy to determine. Probably the chief of these is the fact that, whatever geological difficulties do arise during construction, it is always possible to complete engineering works, whether economically or not, without geological knowledge, and the engineer is not likely to be blamed by his employers for what turns up unexpectedly below ground.

Secondly, there is a pessimism among certain engineers, some of whom, though they may be experienced in excavation work, have little time for geology, and see only a comparatively heterogeneous mass of deposits underground in no sort of order, and to be classified broadly into two types—"rock" and "muck." There is also the optimist, who expects the geologist, by surface indications alone, to prophesy precisely what will be met with in almost every yard of his proposed trench, and, in consequence, loses faith in the accuracy and practical application of the science.

Thirdly, we have scant consideration of the subject in the engineering and geological text-books. The former have already been discussed; the latter, while containing all the necessary elements for the study of the subject, rarely present the applied or practical side of the science, except on the very broadest lines, and include matter that is unnecessary to learn, and which has rarely any direct bearing upon engineering questions.

In the writer's opinion, every engineer should be familiar, first, with the elements of geology—i.e., the principles of stratification, and formation of rocks and deposits, and the various structures occurring in them as the result of formation change, weathering, or earth movements. He should be able to recognize and describe correctly all the common solid rocks and unconsolidated deposits. He ought also to understand a geological map as he does a working drawing, and be able to plot approximately geological sections from it, as well as accurate geological records from borings, trial holes, trenches and tunnels. A training in petrology is desirable for the road engineer, but expert knowledge in this branch of geology usually requires more time than the professional engineer can afford. A thoroughly practical geological training, however, cannot be acquired without considerable experience in the field.

Of equal importance is the subject of hydro-geology. This includes the principles of the occurrence of underground water in different geological deposits, the laws of flow through porous and permeable materials, underground water levels and their fluctuations. The mathematical side of this subject has been considered in great detail by foreign scientists and engineers, but, so far, the quantitative results have been of little direct application to practice, owing to the extreme complexity of underground conditions. Nevertheless, the principles arrived at are of great value in clearing one's ideas, assisting one to anticipate or prophecy, and to deal more rationally with underground-water porblems where a certain amount of local information has already been secured. The value of this science is not only found in questions of water supply, but in the excavation of trenches, cuttings, deep foundations, tunnels, drainage, and the like.

It would be impossible in a paper of this kind to cover the whole of that region in municipal engineering on which practical geology has a direct bearing. The following are merely a few selected instances commonly occurring in practice.

Preliminary Geological Investigations on Important Works

In the majority of important public works it is desirable to ascertain, by means of trial holes or borings, the nature of the ground in which the works are to be constructed. The object of these investigations may be to determine, first, the necessary dimensions of the permanent work and its approximate cost; secondly, the ground-water levels thirdly, whether any saving may be effected by a change in location, if practicable; and, lastly, to enable contractors to make a fair tender for the cost of construction. As regards the latter, it has given rise to discussion among engineers whether data obtained from trial holes and borings should be shown to tendering contractors, because of the possibility of future claims or litigation. Information of this kind, however, allows a contractor to put in a fairer price, and avoids the necessity of his protecting himself, as he often does, by increased prices for unknown ground. Without such knowledge, a contractor's tender must usually be either unfair to the municipal body or the contractor himself; but there are pitfalls, of course, although the more practical geological knowledge there is brought to bear on the investigation, the less will be the risk.

As regards the selection of sites for borings, etc., it is essential that the number of holes should be sufficient to give reliable information, and the strata must be correctly described. Each hole should be sunk to the full contemplated depth of the excavation, and located on the centre line, or within the limits of, and not outside, the work itself.

An interesting example of the result of sinking trial holes clear of the work occurred recently in this country in connection with a tunnel sewer. The trial holes, in order to save expense, were sunk in a railway cutting parallel to the sewer. These proved the ground to consist entirely of sandstone and conglomerate, whereas at least half the length of the tunnel was found to be in marl, the discrepancy being due to the cross dip of the strata. In the sandstone and conglomerate the tunnel was driven without timber, while in the marls close timbering was required throughout owing to falls from the sides and roof. An action was brought by the contractor against the public authority on the basis that misleading information had been supplied to him.

In the solid rocks the selection of the sites for trial holes, etc., can often be much assisted by a knowledge of the surface geology. This is especially applicable to tunnel work and the like; but the majority of municipal works are founded close to the surface, and the nature of the ground is dependent more on the character and depth of the soils, subsoils, and surface deposits of the districts. As the detailed structure and arrangement of the surface deposits cannot be foretold with any accuracy from surface indications, trial holes or borings are essential.

Water Supply

It is, perhaps, in questions of water supply, and especially in schemes from underground sources, that a sound knowledge of geology and hydro-geology is essential. The selection of a site for a well or boring, which will yield a satisfactory amount of pure water, requires intimate acquaintance with the local geology, the order, arrangement and structure and water-bearing characters of its various strata, both as regards its solid rocks and superficial deposits. Familiarity with hydro-geological principles will also assist the investigator in analyzing more rationally from data in local wells and springs, existing underground water resources of the district, and in considering questions of possible pollution from farms, fields, cesspits, cemeteries and polluted streams. Similar principles apply largely to water supplies from springs.

Geological considerations are also highly important in the selection of sites for impounding and service reservoirs, dams and embankments, and in the location and construction of lines of aqueduct, pipes and tunnels; but these are matters, perhaps, more usually in the domain of the consultant, dealing with large schemes, than in the routine work of municipal engineers.

Lines of Sewers and Pipes

In the construction of lines and sewers we find many questions arising where applied geology may be of use in location, design and construction. The most serious difficulties are generally encountered in the unconsolidated deposits of alluvial, glacial, and other recent origin. The beds of clay, silt, mud, running sand and peat, which so frequently occur in these formations, are usually capable of supporting only relatively low pressures, and require great skill and experience in the treatment of cuttings or excavations, being especially liable to slips, and to act as a semi-liquid when their existing stability is disturbed by any excavation within their mass. Occurring, as they do, in the low-lying areas in valley bottoms, estuaries, and mud flats, they are liable to be saturated with ground water, which further reduces their stability, and adds greatly to the difficulties of engineering construction. In addition to the obviously waterlogged ground formed of these deposits in low-lying areas, many lines of pipes and sewers may be constructed in water-bearing rocks, and deposits below the saturation level. The opening out of a deep trench in porous or permeable material below the saturation level has the effect of draining the measures on both sides of the trench, and producing a lowering of the water levels in the vicinity. This may often give rise to claims for damage to local wells and springs. Any trench excavated below river level, in a valley bottom and in permeable strata, will tend to collect a large volume of water, and similarly where the saturation level rises from the valley bottom more or less parallel to the ground surface, a deep trench, although distant from the river, may require heavy pumping during construction. In all permeable surface deposits and permeable strata, such as chalk, sandstone, sands, and heavily fissured rocks, in which trenches are to be excavated, it may be often worth while to determine the underground water-levels in local wells, in order to see whether it is possible to fix the levels of the permanent work above them. Local wells have not infrequently been drained dry during the construction of a deep sewer, and sometimes permanently, so that it has been necessary to deepen them in order to restore their water supplies.

An interesting example of considerations of this sort occurred during the design of the Burton sewerage scheme. Here it was anticipated that a deep-water sewer would affect the yield of the brewers' local wells. Water levels were measured in these wells and borings were made to determine the geological strata. The water levels, when plotted, showed that the proposed deep sewer would be considerably below the saturation level, and that the trench would intercept the water and carry it down the valley. The original scheme was therefore modified, and the sewer raised above the water table through about half the length at the upper or town end.

In considerations of this kind, hydro-geology has shown that the saturation level is subject to seasonal fluctuations; hence it may happen that a trench excavated in dry ground above the saturation level during one part of the year may be flooded during the winter and early spring seasons when the ground water is high.

Heavy pumping and consequent lowering of the saturation level in certain sands, peat bogs, and marshes, may also seriously affect the foundations of adjacent buildings, producing cracks and settlement. Cases are on record where the saturation level has been lowered several feet by pumping, and accompanied at a distance of 200 ft. by a settlement in the buildings of several inches.

In hilly districts, such as parts of Yorkshire and South Wales, for example, sewers and lines of pipes may require to be constructed in steep, sidelong ground and scree slopes. Here there is a strong tendency for the surface material to slip into the trench, and great pressure may be brought to bear upon the timbering, and even upon the permanent work, which may be forced downhill and fracture. Such catastrophies have occurred both on lines of cast-iron pipes and brick culverts in this country.

In certain types of ground, again, such as those formed of steeply dipping shales or clay masses, or surface materials upon a high inclined rock surface, slips are liable to occur, and even the permanent work may require to be strengthened.

Another curious phenomenon is occasionally found in deep trenches wholly in clap deposits, which may appear to be perfectly consolidated and firm during excavation. The weight of the material on both sides of the trench may be sufficient to cause the plastic material to flow, with the result that the timbering must be crushed in and collapse, accompanied by an uplift of the bottom of the trench and of the permanent work. The writer has known of a length of over 100 yds. of culvert invert and side walls destroyed in this way. In some of the glacial clap deposits of Lancashire the trench bottoms have been observed to rise between the operations of trimming the trench bottom and bedding the pipes.

In ground of soft clays, mud, silt, running sand or peat, the difficulties of construction are, of course, at their worst. Special precautions must then be taken from the outset in timbering, strengthening the section of the permanent work, draining, and so dealing with the foundations below formation level as to enable the ground to support the weight of the overlying structure.

Finally, we have those subsiding areas in this country due to coal mining or brine pumping, where lines of water mains and sewers, and especially the latter, are liable to be constant sources of trouble due to unequal settlement of the permanent work. In most instances of this kind the subsiding areas must necessarily be traversed by these lines of works; but it may sometimes be possible to avoid both the affected areas and those liable to future subsidence. Again, problems of surface protection and purchase of the underground minerals may occasionally arise. The subject is too vast, however, to discuss here, but it may be taken for granted that in questions of this kind the engineer armed with a sound knowledge of the local underground geology and its relation to the subsiding surface is likely to be more efficient not only in dealing with lines of pipes and sewers, but with reservoirs, filters, bacteria beds, and other works.

Sites for Sewage Irrigation Farms, Cemeteries, Etc.

In the selection of sites for sewage irrigation areas, the nature of the underlying subsoil is one of the most important factors. Usually extensive stretches of porous or permeable material, such as gravels and sands, prove the most satisfactory land for this purpose. The ground water levels and the direction of underground flow in relation to the nearest stream or river, and the possibility of pollution of local wells and springs should all be investigated. Hence, practical geology and hydro-geology are here both of direct application. Where bacteria beds are in use, and the effluent is comparatively harmless, these conditions, of course, are not so important.

In the location of cemeteries, again, similar investigation is essential. A suitable subsoil, easy to excavate, and capable of standing without support for a short time, is desirable. The maximum height of the ground water should be below the level of the bottom of the graves, and the direction of its flow, where there is any question as to pollution of local wells and springs, should be ascertained, either by actual measurement or by inference from the local geology.

Roads and Road Metals

In the construction of new roads in the colonies or other foreign countries, practical geology may be a very important factor in location, where the choice of a route may be guided by the geology of the district to be traversed. Thus, areas liable to slips, or formed of very soft or very hard material, or requiring heavy retaining walls, may sometimes be avoided by deviation. In this country, however, the routes of the few new roads that are now being, or likely to be, constructed, are more or less fixed within rigid limits. Still, even here practical geology and hydro-geology, when combined with engineering experience, are valuable aids in the excavation and drainage both of the cuttings and the road-bed itself.

As regards the materials for road metals, a sound knowledge of the occurrence and petrology of road stones is decidedly useful. The early experimental and scientific work of Lovegrove, Howe and Flett in this country, and others abroad, was a promising beginning in the scientific study of road metals. The introduction of tar and bituminous compounds, the tests of different materials in actual use on the road, as at Sidcup, and the formation of the Road Board marked further stages. But road engineers are still finding difficulty in arriving at standards of value in road materials, and much practical and scientific work seems still to be necessary, both from the engineering and geological aspects. The modern road must necessarily be a complicated study, containing as it does problems in physics, chemistry, and geology. Perhaps with the establishment, in time, of courses in highway engineering at the universities, so strongly urged recently by Mr. H. P. Boulnois, we may stimulate scientific research in this direction, and, in conjunction with the practical results and experiments of road engineers, evolve a new technology, for which there seems to be a considerable need.

A deep water diving suit was tested in Long Island Sound, off Stamford, Conn., in a depth of 212 ft., which is probably a record for deep sea diving. The suit is in effect a metal casing, looking curiously like a suit of Chinese armor and jointed at the elbow, knee, hip and shoulder, to allow movement of the diver. One arm is provided with a searchlight and the other with a grappling hook. The casing completely envelopes the diver and is of sufficient strength to resist pressures at least as great as that experienced in the test. According to the owner's reports, "no attempt is made to make the suit air-tight, so that all of the water that works in through the joints is kept out by an automatic pump." Air for the diver is supplied through a pipe to the helmet, which pipe also contains a telephone wire.

A framed reinforced concrete engine bed embodying several novel features is now in use at Rockford, Ill. The frame is 11 ft. 6 in. wide at the base and 6 ft. 10 in. at the floor line. Monolithic with the frame are two reinforced concrete engine beds 5 ft. 4 in. long, 24 in. wide and 20 in. high. The rods holding the engine to the bed were not bedded in the concrete; iron pipes were cast in the concrete, leaving openings through the bed proper, through which the bolts were passed after the engine was placed. Heavy washers were placed on the lower end to make a better bearing for the lower nuts. Both ends of the bolts were threaded. A platform 6 in. thick was placed 6 ft. above the basement floor, which served the double purpose of providing a convenient place on which to work while placing the bolts and acting as a stiffener to the columns and preventing torsion due to the action of the double 50 h.p. engine. Although the frame carries a double 50 h.p. engine, scarcely any perceptible vibration has been noted under a full load.

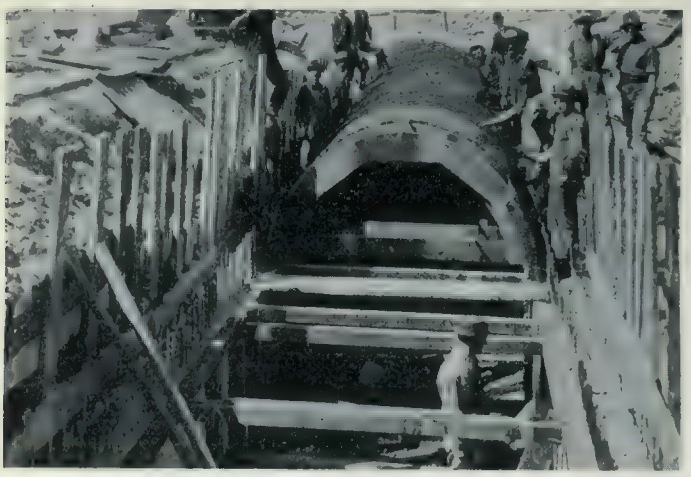
Even where concrete is not specified to go on top of the tile, in hollow tile and joist for floor construction, the contractor should allow enough concrete in the joist to flow over the whole top surface of the tile for a thickness of about one-quarter inch.

The First Unit of Vancouver and Districts' Great Sewerage Scheme

(Staff Article)

OPERATIONS have been proceeding without interruption since last December in connection with the first unit of sewerage construction undertaken by the Vancouver and District Joint Sewerage and Drainage Board as part of the immense joint sewer system embracing the entire area of Burrard Peninsula, which includes 55,600 acres, of which only about 10,000 acres are within the present boundaries of Vancouver, the remainder being in New Westminster, South Vancouver, Point Grey and Burnaby.

It will be recalled that previous to the formation of a permanent Sewerage Board, in 1913, Mr. R. S. Lea, consulting engineer, of Montreal, was retained by a joint committee composed of representatives from each of the municipalities interested—with the exception of New Westminster, to advise them as to a general scheme for the whole peninsula and the best means of constructing and maintaining such a scheme in a state of efficiency. The report, which was submitted early in 1913 and adopted by the committee, advised the formation of a permanent Sewerage Board, this action being carried out forthwith and duly legalized by the provincial government which at the same time granted financial assistance in the form of a government guarantee covering the interest on $10,000,000, the sum for which the board is empowered to issue bonds, and $5,000,000 of the principal.



8 ft. 6 in. horseshoe sewer, China Creek, showing steel reinforcing.

Burrard Peninsula is divided naturally into five drainage areas, which discharge respectively into Burrard Inlet, False Creek, English Bay, Fraser River and Burnaby Lake. Each of these areas was studied as a separate problem in laying out the general scheme, except that the disposal of sewerage from each area was considered in the light of its relation to the other districts or the waters there available for distribution.

The principal discharge into Burrard Inlet will be through an outfall, located at Clarke Drive, which is to drain an area of 8,250 acres with an estimated population of 238,000 in 1950. Parts of the area being made tributary to the Clark Drive sewer will drain into False Creek and Burnaby Lake. The initial work now in progress and steadily approaching completion comprises a portion of the Canoe Creek and China Creek sewers, which the Board decided to construct by day labor. The expenditure to August 1 was $181,000, distributed as follows: labor $114,000, material and stores and plant depreciation $60,000, plant (present value) $7,000.

The work covers the construction of plain concrete sewers and tunnel and reinforced concrete sewers in open trenches. About 70 per cent. of the construction has been completed to date. Nine shifts of an average depth of 25 feet, and 8 x 8 feet across, were sunk at various points in the tunnel during the early stage of operations, and driving was then commenced in opposite directions from each shaft. Altogether, about 3,500 feet of tunnelling has been undertaken in what is known as Contract No. 1. About 1,000 feet of this is through hard pan, most of the remainder being in soft ground, with a small section through running sand. The cost of the miner's piece-work amounted to $5.00 per foot through rock, and $6.00 in soft ground, or $5.50 per foot on an average. The size of timbers used in the tunnel was 8 x 8 feet for the segment sets, with 2-inch logging or poling boards. The proportion of concrete used was one part of cement, two of sand and four of ¾-in. gravel. The method of applying the concrete was first to line the lower half of the tunnel from shaft to shaft and then attend to the roof and upper portions, working from opposite directions towards a given centre, a concrete mixer being placed at each shaft. No reinforcing was used in the tunnel. The sewers in trenches, however, besides being lined with concrete on the same principle as the tunnel, have been heavily reinforced with ½-inch twisted steel except where the ground in the bottom of the trench was sufficiently hard; in such cases no reinforcing was required in the lower half other than for bonding purposes.

An interesting feature of the excavation for the tunnel was the method of hoisting the dirt through the shafts and dumping on the adjoining vacant lots by means of a self-dumping Alaska trolley. This trolley is really the outcome of mining in Alaska, where the cost and supply of labor have always been very material considerations. It is carried on a cable, suspended between the shaft and the dump. A chain attached to the rim of the bucket passes through a loop, which, in turn, slides along a light wire running in a line underneath and parallel to the overhead cable. This loose rope extends down to the bottom of the tunnel shaft where it is securely fastened during the operation of loading the bucket. As the bucket is filled and raised to the surface, the hoisting sheave comes into contact with a hammer attached to the trolley, thus releasing the trolley and enabling it to travel to the dump where a trip, bolted on the loose ground wire at this point, abruptly arrests the progress of the suspended chain, the shock of the contact inverting the bucket.

Practically all of the plant used in connection with this work was purchased second-hand and therefore at comparatively low cost, an expenditure of less than

$8,000 covering the total outlay under this heading. No difficulty has been encountered in obtaining a sufficient supply of labor since the commencement of operations. A force of about 250 men has been constantly employed, the municipal wage rate of $3.00 per day of eight hours being paid.

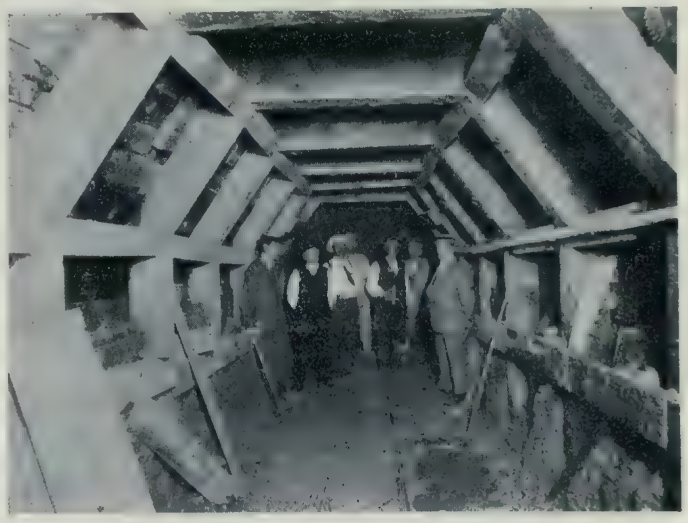
The cost system employed on the work was designed by Mr. L. E. Wilson, the Resident Engineer, and could be conveniently adapted to all classes of construction work. All plant purchased for the job was charged on a rental basis at a rate per day commensurate with the life of same, and at the completion of the work, the difference between the shipping value plus the total rental charged, as compared with the original purchase price, would be a debit or credit balance as the case might be, and apportioned to the section of the job properly chargeable with it. The stores were charged every month directly into each section of the job, wherever possible, and where items of general stores could not be so charged direct for the reason that they would be used more or less on the whole work, then the cost was distributed pro rata between the various sections of the work in the proportion that each section bore to the whole contract, and further subdivided pro rata between concrete and excavation in their respective ratios. All tools such as picks, shovels, hammers, saws, etc., were treated as general stores as it was considered these would all be worn out on the work, and any value they might possess at the close of operations could be easily adjusted in the final statement of the cost. Progress statements of the cost, together with plans, were turned into the chief engineer every month. A stock account was kept of the materials used in concrete and was shown at the top of the monthly cost statement.

Early in the present summer the Vancouver and District Joint Sewerage and Drainage Board decided to proceed with the second unit of its vast scheme, embodied in the estimates under the heading of "immediate construction"—which covers work to be undertaken during the next five years at a cost of $5,500,000—and tenders for the work, which is known as "Contract No. 2," were called, the following being the list of bids submitted by the various firms competing: J. Gault & Co., $396,396.65; Leddingham & Cooper, $376,769.13; Engineer's estimate (day labor), $365,000; Union Contracting Co., $348,546.24; Engineer's estimate (contract), $348,316.90; Moore & Pethick, $340,100.45; Robt. McLean & Co., $333,646; H. P. Peterson, $332,772.80; Hodgson, King & McPhalen, $309,052.72.

Junction of 6 ft. 6 in. and 5 ft. 6 in. sewers with 8 ft. 6 in. horseshoe sewer, China Creek.

The Board awarded the contract to the lowest tenderers, Hodgson, King & McPhalen Bros., of Vancouver, who have made all arrangements for immediately starting active operations. The contract covers the construction of some 2,700 feet of 6-ft 6-in. x 6-ft. 6-in. horseshoe section, tunnel sewer, and about 5,000 feet of reinforced concrete sewer trench with vitrified brick invert, ranging from 6 ft. 6 in. in diameter to 2 ft. 6 in. in diameter, together with about 15,000 feet of reinforced concrete pipe sewer ranging from 42 inches to 24 inches in diameter. The conditions of this contract call for the payment of the municipal wage rate of $3.00 per eight-hour day for all ordinary labor employed. It is estimated that operations in connection with this branch of the scheme, which takes in the Clark Drive outfall area, will require about twelve months to complete.

Further developments contemplated by the Board which has been provided for in the estimates includes the conservation of the natural drainage channels of the Burnaby Lake district, a work that is considered of paramount importance in its relation to the combined system of trunk sewers. Part of this project comprises the deepening and improving of the Brunette River, which is the overflow from Burnaby Lake. The lake itself is a shallow sheet of water with a mean water area of about 430 acres and a maximum depth in the centre of 9 feet. It lies between Vancouver and New Westminster at a point about nine miles east of Vancouver. Owing to the presence of a natural rock dyke which lies across the outlet to the Brunette River and virtually acts as a dam, the lake overflows its banks and floods the low-lying lands in the vicinity during periods of excessive rainfall. The drainage area, estimated at about 26 square miles, resembles a huge, shallow basin with one side broken—the latter conforming to the end at which the dyke is located. The work to be undertaken will consist of the lowering of the level of this dyke to a depth which will permit of satisfactory draining under any circumstances, and the construction of two interceptors for sewage disposal in the district. The chief engineer in charge of the work for the Vancouver and District Joint Sewerage and Drainage Board is Mr. A. D. Creer,



Driving tunnel in soft ground, Canoe Creek sewer.

Mem. Can. Soc. C. E., A.M.I.C.E., who supervised the preparation of the surveys, estimates and designs contained in the comprehensive report submitted by Mr. R. S. Lea in his capacity as consulting engineer.

Experiments in Sewage Treatment

THE results of recent experiments in sewage treatment were given by Mr. J. D Watson, M. Inst. C. E., at a recent meeting of the Royal Sanitary Institute held at Blackpool, Eng. The protracted hot summer of 1911 emphasized a phase of sewage purification which up to that time we in this country had paid little attention to—namely, the relationship between aerial nuisance and the aerobic decomposition of sewage. It then became apparent that even on small works greater attention to this question was desirable, and in some cases imperative.

As a general principle, objectionable smell should be reduced to a minimum, or, to be more accurate, to the lowest point possible compared to reasonable expenditure. He was not sanguine enough to believe that sewage could ever be purified without producing some objectionable odour, but he saw no reason why such work should not be done without attracting the attention of residents in the vicinity of the works, unless the atmospheric conditions were very unpropitious. It should not be forgotten that much could be done before the sewage ever reached the outfall works, for the production of malodours was greatly facilitated by badly designed and carelessly managed sewerage systems. Not the least important part of the work was efficient house drainage if even the best designed and managed sewage system was to fulfil its functions and transmit foul liquid to the outfall before decomposition set in. When the drainage area was large many hours sometimes elapsed before sewage from the outskirts reached the outfall.

Assuming that the aerobic treatment of sewage was desirable, and he thought there could be no doubt that it was so for at least eight months of the year, all questions as to what objectionable smell was due to, and how it could be avoided, became very important. As he understood the question, the elimination of sulphuretted hydrogen, or the prevention of its formation, would in nine cases out of ten render the sewage practically odourless. With regard to the prevention of its formation, Dr. Soper, of New York, had been of opinion for many years that the introduction of a sufficient volume of air in the sewage would render it almost odourless. Mr. Geo. Fuller said that oxygen seemed to be an antidote for sulphuretted hydrogen.. It was a long time since Waring and other Americans first advocated the introduction of air into sewage as an element of purification, and they must all agree that many benefits would accrue from air blowing into sewage, provided that it could be done at reasonable cost. Whether the air should be introduced before it was distributed over the bacteria beds or introduced at an earlier stage he did not suggest; but it must not be forgotten that temperature, velocity of the wind, electrical disturbances, and so forth, all played a part in the matter.

Air-Blown Sewage

After all, however, the preponderant difficulty was the presence in the sewage of sulphuretted hydrogen and the cost of eliminating it. With a view to getting some definite information on these points he began six months ago to make some experiments, but they had not yet been completed. He might say, generally, however, that they seemed to point to the fact that the object could be attained by a system of air blowing at a cost of not less than 27s per 1,000,000 gallons treated. The experiments included air blowing at various pressures and under varying conditions. The sewage before and after blowing was tested for absorbed oxygen in accordance with the Royal Commission method.

Experiment No. 1 was on a 15-in. pipe, 36 ft. long, fitted with eight rings equally spaced, in which were 1/16-in. holes, through which the air was introduced. Experiment No. 2 was the introduction of air into an 18-in. rising main. Experiment No. 3 was with a 2-in. vertical pipe into which was introduced a single air hole, and No. 4 with a hydro machine.

As a general statement he must say that the results obtained by Nos. 1 and 2 experiments were very erratic and inconclusive. In No. 3 complete saturation was obtained in several cases; but in all cases where complete saturation was obtained there was 30 per cent. saturation in the sewage itself. In No. 4 they had various rates of speed. Saturation varied from 30 to 90 per cent. and they found that the higher the speed the better the results obtained; but it was not easy to obtain a 60 per cent. saturation from speeds of 300 to 400 revolutions per minute. They obtained their best result of 92 per cent. saturation at 540 revolutions. The air was supplied by an air compressor worked electrically.

Taking the cost of electric power at ½d. per unit, which was cheap, the cost of fairly complete saturation worked out at ½d. per 1,000 gallons. He was anxious to find out whether it would be possible to aerate the whole of the Birmingham sewage, after it had arrived at the outfall works, at anything like a reasonable cost. The whole of the experiments were going on, and he felt that in speaking of them at this stage he was acting unwisely. His wish was to induce those who had the opportunity to make similar experiments to do so, for there was a great deal of work to do before any definite recommendation could be made.

The new Thames Tunnel for carrying the mains of the Metropolitan Water Board of London, Eng., between Twickenham and Richmond is nearing completion. The tunnel is shield-driven and is lined with cast-iron segments. It is 618 ft. long between shafts, 60 ft. deep, and has an outside diameter of 16 ft. The tube will accommodate five 36 and 30-in. water mains. The present supply mains are laid in the bed of the river.

Borax kills fly eggs, and about 2 oz. per garbage can will prevent flies from breeding. This is the announcement made recently by the Department of Agriculture. Propagation in stables, garbage piles, rubbish heaps and in fertilizer can now be prevented cheaply without lessening the value of the decaying matter for use by the farmer. Borax, to the amount of 0.62 lb., or calcined colemanite (crude calcium borate), 0.75 lb., was found by experiment to eliminate breeding of flies in 8 bu. of fertilizer. It is believed that this discovery will assist health authorities in campaigns against the typhoid fly. Contractors should welcome the method as an aid to keep construction camps free from flies.

The Selection of Pavements for Roads and Streets

By W. H. Connell†

MUCH has been heard, especially during the past eight years, about the primary considerations that should givern in the selection of materials and methods for building various types of roads and pavements. It is fair to say that highway work would be further advanced and on a basis comparable with other engineering problems if the generally accepted principles derived from scientific research and the practical experience of recognized experts had been more generally adopted and applied.

It must be admitted that highway engineering has not kept abreast of the times as compared with other branches of engineering. As a matter of fact, the problem which presented itself with the advent of the automobile and the consequent revolutionizing of traffic conditions is just beginning to be solved, and while it is true that the highway problem would not be so serious as regards country roads were it not for the automobile, it is equally true that it never received the attention it deserved and was generally looked upon lightly by both engineers and public officials; and the highway departments afforded splendid opportunities to parcel out jobs to men from all walks of life and without any qualifications for the work.

The plane upon which highway departments were formerly placed is probably the reason why men from various walks of life, and doubtless with ability along lines other than highway engineering, freely express their opinions as to how roads and pavements should be built, what is the best type of pavement and like questions. In many instances the views expressed are not based on knowledge of the subject or on advice from qualified experts. This, of course, goes to show that highway work as an engineering problem is still in its infancy and that public officials and the public have yet to be educated to an appreciation of the fact that this branch of engineering requires special study and that haphazard statements not based on experience or knowledge are just as unwarranted as they would be in connection with any other scientific subject or business enterprise.

Today, unfortunately, while road builders are trying to solve the problem and build adequate roads, enormous sums of money are being wasted and agitations and investigations are being carried on in different highway departments which tend to make it appear to the general public that engineers are not solving the problem. To a certain extent this is true, not because the men who have made a special study of road building have not the ability to build good roads and pavements but because the work is not under their control. This state of affairs, which is usually the result of highway departments being run by officials without experience or training to qualify them for their work, is the side of the subject which is generally before the public; and it is only through meetings of this kind and through publicity from reliable sources that the public will come to appreciate the necessity of placing highway engineering work in the hands of men who are experienced in that kind of work and qualified for it. In other words, highway engineering must be put on the same plane as other businesses and professions, in which success can not be achieved unless the guiding hand is a master builder in that particular line. Therefore, the most important consideration entering into the selection of pavements for road and streets is the selection of men competent and qualified to build roads and pavements and to plan and control the work in an efficient and economical manner. It is no more difficult to find such men than it is to find men qualified to control work in other lines, and this principle is the most important one for engineers and road builders to drive home at every opportunity.

The proceedings of every highway engineering meeting and road convention contain valuable data in connection with this subject. This, however, is of little value unless it is applied in practice, and, unfortunately, there are many officials who make little or no attempt to avail themselves of the opportunities afforded by the proceedings of such meetings as this. In small communities where the work and the money available are not sufficient to warrant the continuous employment of experts, it is always possible to employ an expert in a consulting capacity, as is done in other branches of engineering, and must be done in highway work in order to secure economy and efficiency.

It is a common occurrence for highway officials to receive communications from other officials asking what they consider the best pavement to lay in such and such a town or on their main thoroughfare. These requests do not give any details as to gradient, traffic and other conditions that must be considered. It is obvious from the character of these letters that there is a deplorable lack of appreciation on the part of many public officials of the necessity of employing experts to advise in this work. A great deal of stress has been laid on the necessity of getting proper advice in connection with highway work since it is apparent that if this phase of the question were given more consideration it would furnish a solution of many of the problems of selecting pavements. Qualified experts would treat each case as an individual problem, giving due weight to all considerations entering into the selection of pavements before selecting a pavement best suited to the particular case.

At present, types of pavements and methods of construction are more or less standardized and there are generally accepted fundamental principles which would govern in selecting a pavement for each particular case, and there is little likelihood that there would be much difference of opinion among recognized experts with respect to general principles. It is likely that the difference of opinion in this, as in other branches of engineering, would be confined to minor details.

After securing an organization with the proper personnel, the most important points in the preliminary study for the selection of pavements are (1) drainage, (2) traffic and probable future traffic, (3) foundation, (4) gradient, (5) local, social and sanitary conditions, and (6) wearing surface.

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† Chief of the Bureau of Highways, Philadelphia, Pa.

In order to select the best pavement for each particular road or street, each one of these factors must be given due consideration.

The failure to make proper provision for drainage is probably alone responsible for the deterioration of more roads and pavements than is any other feature of the construction.

Traffic and probable future traffic are most important considerations, and future traffic in particular is often given too little thought in determining upon the foundation and wearing surface.

The foundation is also a most important matter. In determining upon its type or thickness, the primary considerations are climatic conditions, character of sub-soil, and traffic and probable future traffic. In those localities where engineering advice has been lacking, foundation trouble is particularly noticeable. If a pavement is laid to be more or less permanent, it is a penny-wise and pound-foolish policy to skimp the foundation as it will sooner or later result in the deterioration of the pavement. This point is being emphasized today in all of the large cities, particularly in connection with old asphalt pavements, which, in the early days, were largely laid on Belgian block and broken stone foundations. Such pavements were very well for a number of years but are now beginning to deteriorate. They would undoubtedly have lasted longer on more suitable foundations, as the cause of deterioration has invariably been traced to a lack of stability in the foundation. A foundation should be laid which will last during the probable life of the road in its present layout. The economic features must be taken into consideration; and it would be poor economy to put in a permanent structure if it were likely to be ripped up in ten years or so on account of a change in layout. It is wise to put in a permanent foundation on a road which is going to be a permanent fixture, but many of the country and town roads we are now building are more or less temporary.

The gradient is a dominating factor in the selection of the type of wearing surface and the character of the traffic is the primary consideration. If the traffic is entirely of automobiles or entirely of horse-drawn vehicles the problem is easy; but where there is traffic of both kinds, the pavement, especially on grades, must be suited to horse-drawn traffic and the grade kept as low as possible. With reference to the gradient, pavements may be divided into two classes—smooth and rough. In each class there is a number of standard types and each case is a problem in itself, in solving which the percentage and character of horse-drawn and automobile traffic must be considered.

Social, local and sanitary conditions should be given a great deal of weight in selecting pavements for either cities or towns. There are frequently cases where asphalt or wood block is laid on heavy traffic streets in preference to granite block. Such a course might be justified on the score of noiselessness even if the maintenance charges were more than those for a noisier pavement. Noiselessness might also outweigh all other considerations in the selection of a pavement to be placed in front of a hospital or school where, regardless of traffic conditions, any additional expense would be warranted to secure a pavement as nearly noiseless as possible. Another reason for deviating from what would ordinarily seem to be the best engineering judgment in the selection of a pavement might be the necessity for choosing the most sanitary pavement, as, for example, in the slums of large cities where children are constantly in the streets. A third important consideration in the selection of city pavements, and one which has been given very little attention in the past and upon which there is comparatively little data, is the cost of cleaning. It is a question whether under certain traffic conditions it would not be more economical to put down a pavement with a smooth surface that would not stand the traffic as long as the more durable and rougher pavements, on account of the lesser cost of cleaning the smooth pavement. The cost of cleaning a pavement is a direct maintenance charge, but thus far has been given very little consideration in connection with the determination of the cost of maintenance. This is an important consideration, and the time is close at hand when no city pavement will be selected without considering the cost of cleaning per square yard as part of the cost of maintenance. The social and local conditions are also important and are too often neglected. The value of a pavement in keeping with the character of local conditions can not be overestimated.

After choosing the class of pavement suitable to the gradient, the selection of the wearing surface depends upon the traffic and social and local conditions, the amount and character of traffic and probable future traffic being the dominating factors. This requires careful study. Many roads today are deteriorating because this important consideration was neglected and the wearing surface, although ideal under some conditions, is not adapted to the kind of traffic to which it is subjected.

After proper consideration has been given to all of the factors entering into the selection of a pavement and the pavement has been constructed, the most important part of our work begins. We have built the structure; now we must maintain it.

The principal cause of the deterioration of roads and pavements is the lack of appreciation of the importance of maintenance. There are innumerable well-built roads and pavements that are deteriorating because of lack of maintenance. This is particularly true in America, probably because being a new country only lately has engineering talent been considered essential to the construction and upkeep of our highways.

To sum up, the keynote of the solution, not only of the problems relating to the selection of pavements for roads and streets but also to the whole highway situation, is to be guided in our work by the advice of trained and experienced highway experts. If we do this we will not be apt to go wrong in the selection, construction or maintenance of our roads and pavements.

Overhead wires at Richmond, Indiana, are carried on pole lines of which every seventh pole is concrete. A 25-ft. pole, 11 ins. square at the butt and 6 ins. square at the top, costs $7.65, not much more than a good cedar pole when dressed and treated ready for setting. The setting cost is somewhat heavier than for wood, but the advantage of positive anchorage of the line at short intervals more than offsets the added cost. During a recent storm a 35-ft. concrete pole, anchored in two directions, was so severely strained by the fallen line on both sides that one anchor was pulled entirely out of the ground. When the strain was relieved the pole went back into place without apparent harm.

An Unsupported Pavement

Contributed by Herschel H. Macdonald

FOR sixteen months a rural brick pavement seventy square yards in extent, has hung over the void near Tinker's Creek, Cuyahoga County, Ohio. Now the county commissioners are preparing to put a roadway and a base under their pavement.

There is no apparent reason for their step, except the caution which is always counted an official virtue. The pavement had projected like a roomy shelf over the void, eighty feet long and 6½ feet in width, ever since March, 1913. For some time the pavement was used without a guard rail. Later a guard rail was erected to keep vehicles from venturing over the edge of the shelf.

It will be remembered that floods visited Ohio in March, 1913. Dayton was the heaviest sufferer. Northern Ohio, owing to the depth of its river valleys, escaped with little damage. Part of the damage, however, occurred where Tinker's Creek ran parallel to Dunham Road. At this point a retaining wall of heavy stone blocks had been erected and the road built up to a height of some twelve feet above the bed of the creek. Upon the fill a modern brick pavement with a concrete base had been constructed.

The flood completely submerged the road for several days, and when it receded it was found that the wall had been undermined and scattered for a distance of several hundred feet down stream. Nearly half of the roadway had been excavated by the force of the water and the concrete base, deprived of its support, dropped to the bed of the creek.

All that remained was the actual pavement, an unbroken surface of well-grouted brick. The first impulse of the road authorities was to break down the brick shell, to prevent its use, and to rebuild the entire road from the bottom. A man with a sledge was set to work to demolish it. When he had labored for ten minutes and had only broken a single brick, the man in charge decided that such a pavement could not be much of a menace to traffic and so allowed it so stand.

The fame of the phenomenon spread and people came by the score to behold a highway supported by the ether. Innumerable automobiles ventured to the edge of the overhang, until caution dictated a fence along its edge to prevent vehicles from plunging into the creek. A portion of the width of the overhang, however, has always been subjected to traffic since the washout.

The incident has proved a most effective lesson in a cardinal principle of good paving practice, a principle which has made Cuyahoga County roads conspicuous throughout the country. That is, the proper use of a grout filler composed of one part Portland cement and one part of fine sharp sand.

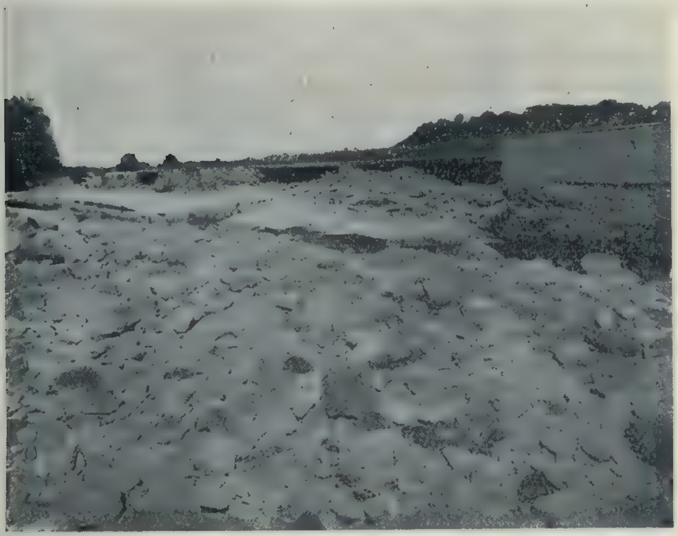
This lesson was not learned in a day, either in Cuyahoga County or elsewhere. Its experimental era was marked by many roads of merit. The early builders were fortunate in being allowed to correct their own mistakes, as well as in the fact that they prepared a type of road that would withstand automobile traffic long before that traffc could have been foreseen.

The Dunham Road pavement presents no unusual features, excepting the strong test to which it was subjected, which impressive as it is, was not made under conditions the identical of which might be found in any properly constructed brick highway.

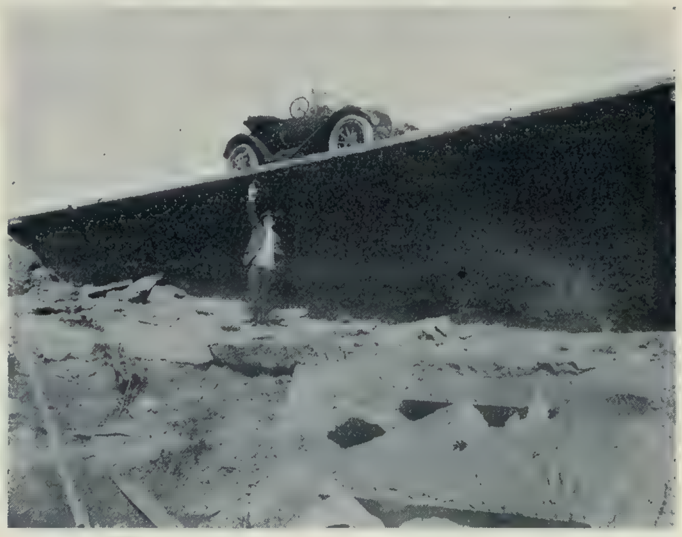
Arch action can have played no part in maintaining the pavement's position. The longitudinal grade of the unsupported portion is an almost perfect level. There is a slight lateral crown comparable to a half-arch, but it is the crown rather than the base of the arch which is supported. The base has no support excepting the lateral bond.

Lest authorities seem to have been remiss in allowing repairs to be so long delayed, it is only fair to say that the principal delay was caused by a project to divert the road, which would have involved the condemnation of land and other lengthy controversy. The delay, however, has been an advantage from the standpoint of the test, as time and the frost action of a severe winter have made the demonstration daily more impressive and opportunity has been afforded for a large number of paving experts to visit the scene and glean such practical lessons as might be had from close inspection.

Cleveland and Cuyahoga County now boast more than one thousand one hundred miles of brick paved city streets and country roads.



The flood washed away the retaining walls and the earth beneath the pavement, undermining the road to a depth of six and one-half feet.



Despite the fact that the ground was undermined as stated, it was able to support the weight of an automobile.

WASHOUT OF BRICK PAVEMENT AT TINKER'S CREEK, NEAR CLEVELAND.

Curtailment of Water Waste and Selection of Meters at Milwaukee Water-Works

DURING the past five years the average daily increases in the water consumption over the preceding year have been as follows:

	Daily increase, gals.
1909	2,304,626
1910	6,407,698
1911	2,259,804
1912	2,779,178
1913	370,424

At the rate of increase prior to 1913 the capacity of the present intake tunnel would be inadequate to meet the demand during the period of maximum consumption long before the new Linwood Ave. intake now under construction, could be completed. This was fully realized by the department about two years ago and all efforts since then have been directed towards eliminating unnecessary waste of water.

Compulsory meterage of all unmetered service, including services supplying the public buildings, parks and grounds; sealing of automatic fire sprinkling systems; sealing of all private fire hydrants, rigid inspection of all premises where water is used for building construction purposes prior to the setting of the meters, and a general inspection of the distribution system, service connections, fire cisterns, etc., was the program mapped out.

Proof that the unmetered services and Automatic Fire Sprinkling Systems caused most of this excessive increase is forcefully shown by the insignificant increase in the pumpage for the year 1913 and the extraordinary increase in the revenue per 1,000,000 gals. pumped since all services are metered and the sealing of the automatic fire sprinkling systems.

The revenue per 1,000,000 gals. pumped for the past years has been as follows:

1911	$45.80
1912	46.76
1913	49.84

As compared with 1912 the increased revenue per 1,000,000 gals. pumped amounts to $53,879.23, in the aggregate. No better argument can be advanced for the maintenance of a water waste department and the efficiency of water meters than the results shown above.

Selection of Meters

There are at present 59,233 water meters in service in Milwaukee. This includes all sizes from ⅝ in. to 12 in. of about 34 different types. When the city first started to meter its taps, which was about 35 years ago, there were few makes of meters on the market. At that time the meters were the property of the water department. Later on objection was found to this and a change was made, so that the meter was required to be furnished by the consumer and maintained at his expense. It is to be regretted that this change was made.

Waterworks, both municipal and private, throughout the country, generally, have found it advisable to own and supply the meters rather than have the consumer supply them as is done in Milwaukee.

It is vital to the success of the meter system that the water department shall determine the meter to be used and the manner of setting, the time for testing and repairs. This can better be accomplished when the meters are owned by the department, as the necessary red tape, delays and expenses involved in sending notices to the owner or occupant and such trips to take off and reset the meters, are avoided. The department also can buy fittings in wholesale at prices lower than those usually charged by the plumbers. Meters purchased in large quantities can be bought at a better discount than is given a plumber, who must necessarily buy them in smaller numbers.

Much time and expense would be saved, yearly, if the meters were the property of the department. As it is now when a meter becomes out of order it is necessary to take it off, insert a connection pipe and average the account during the time the meter is off. This averaging of the account quite frequently meets with objection, as it is impossible to determine if more water was used or less than ordinarily, during the time the meter is off. After the meter is repaired it has to be sent back to the premises where taken off and reset. Two trips are required for each meter that has to be repaired; one to take it off, the other to reset.

Were the meter the property of the water department, when a meter would be found out of order it would be taken off and in its place a meter in perfect condition would immediately be set, in place of the by-pass, as at the present time. These defective meters would then be brought to the shop to be repaired and put in stock and used to replace others, when they become out of order. Fully one-half of the teaming expense could thereby be eliminated.

Competition in the meter business has brought out many makes and styles. The scramble for business has reduced the prices of meters, as well as brought on the market several makes of meters of cheaper construction. Some of these are not perfect in workmanship and trouble is experienced in repairing these meters, as the parts are not standard. Some manufacturers of meters change the style or model of their meters too often. This makes it necessary to add to our stock of repair parts. It has also been found impossible to get repair parts from the manufacturers for some of their models, making it necessary for the department to condemn the consumer's meter and requesting him to buy a new model.

The department, with no specifications as to the style and quality of meters, has, therefore, received meters of practically all makes. Experience has shown that sometimes some makes of meters will pass splendid tests when being tried in the shop, but after they are in service a short time they do not retain their accuracy on a par with other standard makes, requiring considerably more attention and causing innumerable troubles. Under the present arrangement it is a difficult matter for those in charge to bar or condemn meters of such nature.

If the department controlled the purchase of the meters, this condition could not prevail. At the present time it is necessary to carry about $10,000 worth of repair stock on hand at all times, in order to repair the 34 different styles of meters in service. The department, by controlling the buying of meters, would confine itself to a few standard makes, judged by their merit and render it unnecessary to carry such a large amount of stock, as at the present time.

From the large number of meters coming in the shop for repairs it was found that by far the greater number were brought in on account of failure to register, caused by corrosion of the interior of the cast iron outer housing, which in time interfered with the operation of the train gear. The galvanized coating of the casing apparently afforded but little protection as meters brought into the shop after a few months of service frequently showed evidence of corrosion. As the water meter is the property of the consumer and must be maintained by him, meter repair bills are not looked upon with particular favor by the consumer. The department, therefore, decided to prohibit the use of cast iron meters of the sizes of ⅝ to 2 ins. in diameter, feeling that in so doing a large percentage of repairs would be eliminated. With this in view the rules were changed so that hereafter meters of the sizes of ⅝ to 2 ins. inclusive must be of the best bronze composition; meters above the size of 2 ins. to be of the best grade of grey iron. The difference in the first cost between a ⅝-in. bronze and an iron meter does not exceed $1. Bronze meters are cleaner and more sanitary than iron meters, are less apt to get out of repair and will serve to make water meters more popular. Unfortunately this change was not made at a time when there were but few meters in service.

In order to raise the standard of the meters being offered for installation, a resolution was passed by the common council, that meters must be of such a type or types, as shall be approved by the water department. The construction of meters to be as follows:

> The outer casings of all meters of the sizes of ⅝-in. to 2 ins., inclusive, shall be made of a good grade of bronze composition and finished with a bronze coating to give a uniform appearance. Cast iron frost bottoms with interior surface brass lined will be permitted. The outer casings of all meters in excess of 2 ins. shall consist of a good grade of close grained grey iron and shall be painted or coated with a good water-resisting paint or coating. The measuring chambers and gear trains for all meters shall be made of good wearing, non-corrosive hard bronze. Discs and propeller wheels shall be made of the highest grade of vulcanized hard rubber.

Experience has proven that an all brass meter is a great deal more satisfactory than an iron casing meter and the registration of a brass meter is not impaired by rust, as was found in many of the iron casing meters, even though thoroughly galvanized. As most of the outer casings of meters in service are made of iron, it will be the policy of this department to replace the old iron parts with brass instead of iron, whenever found necessary, so that, eventually, the iron casing meter will become obsolete.

The different size services ranging from ⅝ in. to 12 ins. and the various uses of water makes necessary different styles of meters. The disc type of meter, which is the most modern and generally approved meter for ordinary domestic supplies, is made in sizes of ⅝-in. to 4-in. inclusive. It is proving successful on these services up to 2 ins. The 3-in. and 4-in. disc type meter should be discouraged.

In large buildings and manufacturing plants, where a 3-in. or larger service is required, a meter of current or compound type should be installed. The current type meter, which is made in sizes from 3 ins. and larger, is designed, primarily, to handle large volumes of water with a minimum loss of pressure. They are so constructed that the working parts can be inspected or taken out and repaired without removing the entire meter. They, also, retain their accuracy remarkably well and the expense of maintenance is considerably less than that of the old plunger type of which we have quite a number in service. It is the best suited meter, where large volumes of water are constantly used, such as in large manufacturing establishments, standpipes, etc.

In cases where small streams are likely to be used, the best meter would be a compound type. These meters are designed to handle large volumes of water and will also register on small flows accurately. They are made in sizes of 2 ins. and up. A number of these have been recently installed in the city of Milwaukee and have proven very satisfactory. The installation of compound meters should be encouraged in large flat buildings, office buildings, factories, etc., as they insure the maximum revenue, where there is a great fluctuation in the amount of water used.

Oil aids in preventing the warping of wooden forms, as wood that is proof against moisture is less liable to check or warp than wood that is untreated.

It is very important that sand when used as an aggregate for concrete be well graded, for upon the close packing of the grains depends largely the efficiency and economy of the mixture. The coarse grains should predominate. However, the sand should not contain an unreasonable amount of coarse particles.

While counselling caution in every Department, state or otherwise, where expenditure is concerned, we feel very strongly that this is a time when government bodies should make the most generous provision possible for carrying on public works. In hastily curtailing their programmes, a number of provincial governments have distinguished themselves by a lack of foresight and failure to appreciate the most vital responsibility laid upon them—that of helping to maintain the welfare of the people and preserve the internal stability of the country. There are abundant reasons for utilizing funds, or securing money at the best terms possible, for the resumption of capital expenditures upon public buildings in course of construction upon which work has stopped, and for co-operating with municipalities in the provision of good roads.

Photographing engineers' or architects' blueprints is not an easy task without the proper plate and color filter, it being impossible to produce satisfactory results by using the ordinary plate. B. N. Rhoads, photographer, of La Salle, Ill., has found that ordinary orthochromatic plates, with yellow filters, do not give the best results with such a subject, owing to the fact that a great deal of the yellow-green light to which such plates are sensitive is reflected by the blueprint. This trouble has been eliminated and satisfactory results have been obtained by using a deep red filter with panchromatic plates, thus photographing the print by red light, which completely absorbs the blue. With such a filter and plate the negatives made from blueprints have been found to be as satisfactory as could be obtained from photographing a black-and-white print in the ordinary way. The photography of purple or violet typewriting can be accomplished by using a green filter and plate.

28(35) 1914

The City-Manager Plan of Municipal Government*

THE city manager is the latest innovation in the government of American municipalities, and strange to say, he is a direct indirect result of the Galveston hurricane. When fourteen years ago wind and wave conspired to wreck the Texas island city, the conditions created by the catastrophe demanded so much progressive and constructive work of the city government that the old system of a board of aldermen and the usual string of independent elective officers broke down. A group of business men petitioned the state government to suspend the local government and replace it temporarily with a commission of five men. This was done, and the whole city was put under the control of these men, on a strictly business administration. The commission in a few days accomplished what a city council would have required months to do.

Des Moines, the Iowa capital, took up the idea, and improved upon it, and from that beginning the commission form of government has spread with surprising rapidity through the United States, and a peaceful revolution in four hundred cities has swept away the boards of aldermen, mayors and a host of minor officials and has set up new municipal governments on a plan so simple that the services of the "political boss" are not required to direct them.

How and Why the Commission Plan Fails

The commission form of government has placed in the hands of the people an effective instrument of control; a governing organization which is continuously exposed to the full glare of public opinion, which really came from the voters, and which was sincerely anxious to obey them. While this form of government is a vast improvement over the form in general use up to seven or eight years ago, there is unquestionably room for still more improvement. In some of the cities it has proved very successful, while in others it has been a complete failure. This must not be regarded as a defect in the form of the government, but rather as due to the inefficiency of the members composing the commission. Take, for example, Wichita, Kan., where, as everywhere else, the commission plan was hailed five years ago as a "business plan" of city government which would settle all the difficulties under which the town had been laboring. Recently, the commission in this city has authorized the issue of $88,000 in five-year bonds to cover current deficiencies. After four years of the new rule, that does not look like good business. A little searching into the local situation reveals certain things which are directly or indirectly responsible for this condition.

One of the members of the Wichita commission is an ex-street laborer. Street work as a laborer is an honest calling, but does it give a man quite the preparation for managing one of the departments of a city as important as Wichita? There was doubtless excellent reason for electing him, for the labor people had an unquestionable right to select one of their men to represent them in a city's governing body. The man in question had a reputation for integrity and honesty, but even commission government has not made him a good business manager.

Here, then, is one trouble with the commission plan which the Wichita incident brought out in a graphic way: it is only by accident that you can secure five men who will be at the same time representatives of recognized divisions of the people and properly equipped for administrative service.

What, then, is the substantial and permanent contribution of commission government to the city problem? The one great thing it has done is to demonstrate beyond a shadow of a doubt the wisdom of giving over to a single elective governing body all the municipal powers. It has given the people a workable instrument, so far as general regulation is concerned, but it has failed to give the governing body the means with which to translate the general will of the people into detailed acts of government in the most effective way. A five-headed government carries with it the possibilities of friction, leads to inefficiency, which, in turn, leads to waste and even corruption. Furthermore, municipal experts cannot be secured by popular election.

The city-manager plan does away with this five-headedness of municipal administration and substitutes a single head, not with advisory powers merely, but, subject to certain safeguards, with the powers of administrative "life and death," through actual control of appointments and removals.

The chief executive or city manager is not an elective officer, but is appointed by the council. He therefore does not divide responsibility with the council, but is subordinate to it. He need not be, at the time of his appointment, a resident of the city, but may be chosen from anywhere in the country. He is not chosen for a definite term, but holds office so long as he gives satisfaction to his superiors.

The controlled-executive plan filters everything through a group. It reduces the personal equation. Without loss of administrative unity, it abolishes one-man power. A single man may have his ups and downs, his freaks and fancies, his militant points and his passive ones, his natural bents and moods, his pet departments and projects. A board, or commission, or council, or parliament, has none of these things—to a group such excesses are relatively impossible. Even if all the members were cranks, their combined judgment would be reliable—they would neutralize each other.

This plan corresponds to the general manager under the board of directors in a business corporation. It gives the stability of the combined judgment of many men on matters of policy, but leaves execution to a single-headed controlled executive establishment.

For the highest efficiency we must put the chief administrative official, as well as subordinate officials of the same sort, on a professional basis. This means simply that we must leave his selection and his indefinite retention to some person or body that is in a position to examine his work closely and therefore judge of it intelligently, and that we must also take the matter out of politics, not by incessantly harping on the desirability of doing so, but by relieving him of all except purely administrative duties. That is not saying, you will notice, or even implying, that "the people cannot be trusted to choose" the chief administrator. It is implying merely that they are not in a position to do so to advantage, and that if the official in question is given the veto and other policy-determining functions, neither the people nor anybody else can be expected, no matter how well they realize the advantage of experience in administrative work, to do anything but oust him as often as his opinions are not in conformity with those of the majority.

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*By Paul E. Kressly, City Manager and City Engineer of Inglewood, Cal., writing in The Engineering News.

We are confronted with the question: From what profession or calling shall this important position of city manager be filled? My answer is, that the city manager should be a civil engineer, with municipal-engineering experience; who should also possess the additional qualifications of an economist, a financier, and have executive ability.

What other profession has men who are better qualified as municipal experts than the engineering profession? Are not the members of the engineering profession, in the course of their education, field work and research work, peculiarly qualified for executive duty developed by their training and experience? Engineering is perhaps as much a matter of common sense as of education, and the engineer, to succeed, must have both. Therefore, a capacity to get at the facts in any case, supplemented by good judgment, are predominating traits, characterizing this profession more prominently as essentials than is the case with any other profession or calling.

The board of trustees of the city of Inglewood followed the very rational plan of appointing their city engineer, the writer, as city manager, he having served the city in the capacity of city engineer for two years.

My ideals as a basis upon which to erect the superstructure of my organization were efficiency and economy. In order that my administration should be successful, I was compelled to strictly adhere to my ideals and, in consequence thereof, I was obliged to make quite a few changes in the organization of several departments. On account of having been city engineer, I was familiar in a general way with the weaknesses of the various departments, and in order that they be corrected, I determined that the requisites of all employees should be efficiency, economy, honesty and loyalty, and that employees who possessed these qualifications should be retained regardless of their political faith.

With the requisites thus set forth, a few dismissals were necessary, as this city, like many others, was not without political officeholders, who held positions regardless of their qualifications or fitness.

I will not attempt to describe the reasons for the dismissals, but I wish to state that if any of my fellow-engineers ever receive the appointment of a city-managership, and they are obliged to dismiss employees, they need not be discouraged by threats and wild epithets being hurled at them by "political bosses," and their followers, since this is a natural procedure in the course of uncovering the "efficient" and "economical" work of their "pets." There is an erroneous impression grounded in the minds of so many municipal employees that they are not required to do as much work as for a private corporation; that they need not take any particular interest in the work; that working hours need not be observed; that they can take a leave of absence of a few hours every now and then, without consulting the head of the department, and at the same time be entitled to full wages; that they need not be courteous and accommodating to the public; that they can waste materials or supplies because the city pays for them. They labor under the pretext of the old political saying "to the victor belongs the spoils," and are therefore justly entitled to be given employment, and to do whatever they please, irrespective of the quality or quantity of the work performed, or of their value and worth to their employers, or interest taken in the business affairs of the city.

Specific Achievements at Inglewood

The following is a brief summary of some of the important movements undertaken and changes made in the various departments of Inglewood:

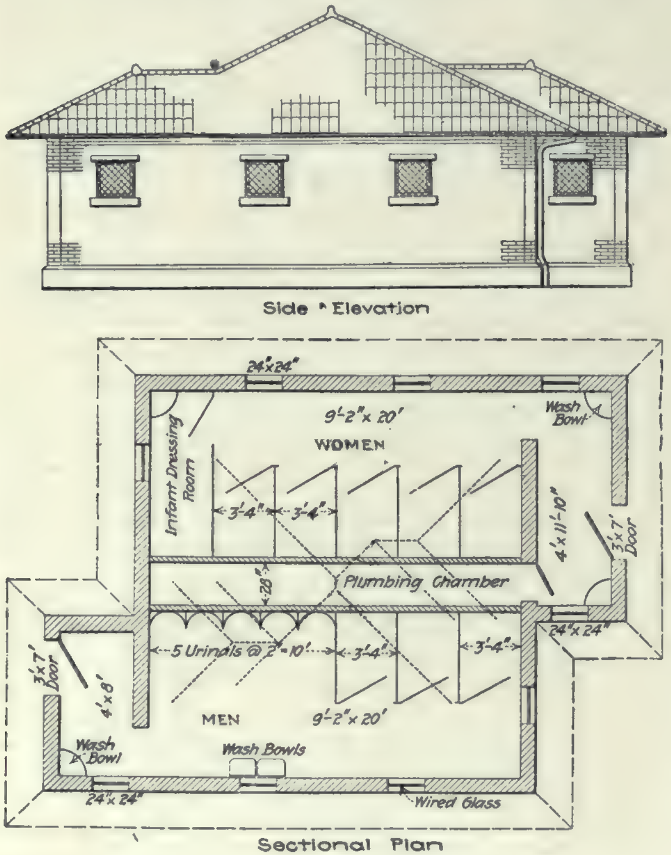
1. The removal of inefficient and incompetent men from the city service.
2. Requiring all employees to obtain an order, signed by the city manager, for the purchase of machinery, tools, supplies, materials, etc.
3. Accounting system installed and providing balance sheets of all accounts.
4. Limiting all city departments to a limited expenditure, and providing for an emergency fund, all within the actual revenues of the city.
5. Monthly detailed reports from each department.
6. Installation of unit-cost system, where practical in all departments.
7. Enlarging and defining the duties and powers of the Park Commission to exercise control and supervision of all parks and street tree planting, and of beautifying the street and avenue parkways by the formation of assessment districts to pay the costs and expenses thereof.
8. Arranged with electric light and telephone companies to have poles removed from streets and avenues into alleys.
9. An Ordinance prohibiting the trimming of street trees by property owners, and delegating these duties to the park commission, and prohibiting the destruction of shade or ornamental trees, shrubs and flowers, and providing penalties therefor.
10. A Resolution providing for the removal of weeds from street parkways, at the expense of the property owners.
11. Commission appointed to revise building ordinance.
12. Commission, composed of five members, one each from Grammar School Trustees, School Teachers, Parent-Teachers Association, Women's Club and City Manager, to arrange for the improvement and beautification of school grounds.
13. Providing more convenient and enlarged quarters for the Public Library.
14. Establishing more stringent rules and regulations governing the care of buildings and apparatus in the Fire Department.
15. Increased the efficiency of the Building, Plumbing and Electrical Inspectors' Department, and placed it on a revenue-producing basis.

There has been much speculation as to the cost of building the Panama Canal, so that it is interesting to learn from figures just published that the expenditure up to March 31 last was rather more than $204,000,000. This was in the Department of Construction and Engineering. The total expense for all purposes was $323,000,000. The smaller figure covers the actual building of the canal, including the cost of the machinery used in its construction.

A Public Comfort Station with a New Feature

THE accompanying plans (reproduced from the Engineering News) show a public-comfort station which will be built in the city of Youngstown, Ohio. The design shows an arrangement similar to that used elsewhere, but with an interesting addition in the shape of an infant's dressing room, which is partitioned off from the women's compartment.

Brick walls, tile roof on wood roof-framing, a brick main dividing wall, and concrete floors, form the shell of the structure. The interior partitions will be of wood, as unfortunately the appropriation happens to be too small to provide slate or other fireproof partitions.


Side Elevation

Sectional Plan

Floor plan and side elevation, public comfort station.

The design secures what is believed to be a structure of excellent appearance at a low cost. The cost is estimated at $2,500, of which the plumbing makes up nearly $1,000.

Paint on Cement or Concrete Surfaces

A paper on "Paint Protection for Portland Cement Surfaces," by H. A. Gardner, Washington, D.C., has for its object the determination of what constitutes a suitable paint for the protection and decoration of exterior and interior stucco walls constructed of Portland cement, and for decorating and rendering wear-proof Portland cement floors.

In April, 1912, Mr. Gardner instituted in Washington a series of tests to determine the durability of various types of paint upon Portland cement surfaces exposed to the weather. The panels for the tests were prepared by constructing a long board wall to which was fastened expanded metal. A mixture of 1 part of Portland cement and 2 parts of clean Potomac River sand was made and applied to the expanded metal, forming a cement wall 3 in. in depth. The wall was divided into 35 sections or panels, each 30 in. wide and 40 in. high. Three coats of paint were applied to each panel by a practical journeyman painter. In order to make the test more severe, nearly all of the paints were applied in white. (Tinted paints are known to be much more durable than white paints.) A strip of chrome green, 6 in. wide, was placed over the top of the third coat of paint, in order to determine whether or not the lime which might be present on the surface of the cement would have any effect upon the paint coating. Fading of the green to a yellow would indicate such action. A priming coat of 25 per cent. zinc sulphate solution was applied to the panels, to neutralize any free lime, but this is held to be unnecessary if the surface is dry when painted and will not be exposed to the weather.

The tests showed that the amount of free lime in fairly dry cement surfaces does not adversely affect high-grade oil paints. The tests also showed that zinc sulphate may be used with excellent results as a primer to neutralize free lime in damp cement surfaces which are to be painted.

Opaque white pigments, such as basic-sulphate white lead, basic-carbonate white lead, zinc oxide, and lithopone, were present in the paints which gave the best results. In some of these paints there was present a percentage of inert pigments, such as barytes, asbestine, whiting, china clay, gypsum and silica. The scaling of varnish paints, which developed in several tests, apparently showed that resinous paints are not well suited for cement surfaces.

The oil paint is not attacked by the dry cement, and holds both texture and color. Equally satisfactory results were obtained with boiled linseed oil, mixtures of raw and boiled oil, and mixtures with Chinese wood oil. Such simple paint coatings were also found to be excellent for concrete floors, being durable, wear-resisting, and dust-preventive.

The results of these tests are quite in line with the results obtained by Ware and Schott in a series of paint exposure tests made upon exterior concrete surfaces. They also agree with previous long-time exposure tests made by the author.

As a result, therefore, it can be stated that excellent results may be obtained by treating cement walls or floors with paints made with raw and heat-treated linseed and Chinese wood oil, containing durable, wear-resisting pigments. When the cement surface is freshly laid and damp, such paints may be safely applied after treating the cement with a zinc sulphate primer.

The general results of the tests at the end of a two-year period, together with an outline of the composition of the paints tested, is given as follows:

Class No. 1—Single-segment paints made with white lead or zinc oxide ground in pure linseed oil. (These paints are in very good condition throughout).

Class No. 2—Combination-pigment paints made of mixtures of white lead, zinc oxide or similar pigments ground in pure linseed oil. (These paints are in generally excellent condition).

Class No. 3—Combination-pigment paints ground with mixtures of raw and heavy-bodied linseed oil or with treated Chinese wood oil. The viscosity of these oils requires the use of considerable turpentine or other thinner in the manufacture of such paints, in order to make them of the right viscosity for application. Semi-flat surfaces are therefore produced during the drying. (Most of these paints are in excellent condition).

Class No. 4—Single and combination-pigments ground in oil varnishes containing acid resins. (These paints are checking and scaling in many spots. Such varnish paints are apparently not suited to exterior exposure).

Class No. 5—Paints containing resins dissolved in volatile spirits (spirit varnishes) with or without pigments. (These paints are not giving very satisfactory service, the clear varnishes having entirely decayed in some cases. Those to which pigment has been added are in somewhat better condition).

Class No. 6—Paints made with single and combination-pigments ground in a water medium containing glue or casein as a binder. (These paints are chalking rapidly and are not moisture-proofing the cement. The pigment binder has been destroyed by the weather).

Typical Specifications for the Wiring of a Residence

WE print herewith a typical set of plans and specifications for the wiring of a residence of average size. The dimensions of the house, verandas excluded, are 38 x 26 outside measurement. It is not expected that these plans will coincide with the individual tastes or requirements of every house builder. We believe, however, that they represent a fairly ideal installation taking into consideration the comfort and requirements of the average citizen. In this connection we mention below a number of features which, without adding anything appreciable to the cost of the installation, materially assist in perfecting the refinements of control and make for convenience and economy of operation.

(1) Absence of brackets—It will be seen that there are practically no wall outlets, these being confined to the one in the pantry, one in the attic hall and one in each of a number of closets. Even in these isolated cases a little added expenditure would have been justifiable and have made the installation, in our estimation, still more perfect. The idea is, however, that all brackets shall be controlled by pull chains, these being especially satisfactory for the closet lamp which is intended to be installed immediately above the door way with the chain hanging three or four inches below the frame; this can be picked up easily in the dark by running the hand along the top of the frame. The objection to brackets is daily becoming more universal. They are generally in the way of furniture or decorations; they collect dust and dirt; they engender untidiness as they are often used as hooks, and at best they only localize the light. All the advantages of the wall lamp, without the disadvantages, are found in the baseboard receptacle of which these plans show a liberal number.

(2) Arrangement of circuits—The baseboard receptacles in this plan are kept on separate circuits by themselves. This arrangement gives two circuits in every room so that in the event of an interruption on one circuit the room will not be left entirely without service and a fuse being blown by a fault developing in a worn flexible cord will not interrupt the lighting of any regular ceiling outlet. This gives a somewhat larger number of circuits than is absolutely necessary and takes a few feet more wire, but it has the advantage of allowing a liberal capacity on every circuit so that if an unexpectedly large load is taken from any outlet that circuit is not likely to be dangerously overloaded.

(3) Special closet outlets—As already noted a small wall lamp is provided above the door in each closet. The additional expense for these outlets is very small, the current consumption will be negligible and the added convenience, especially in closets the shape of those shown, is very material indeed. Especially where clothing or supplies is placed on shelves a good lighting is necessary to maintain a proper tidiness. Such a light in the medicine closet will tend to prevent the use of carbolic acid for castor oil.

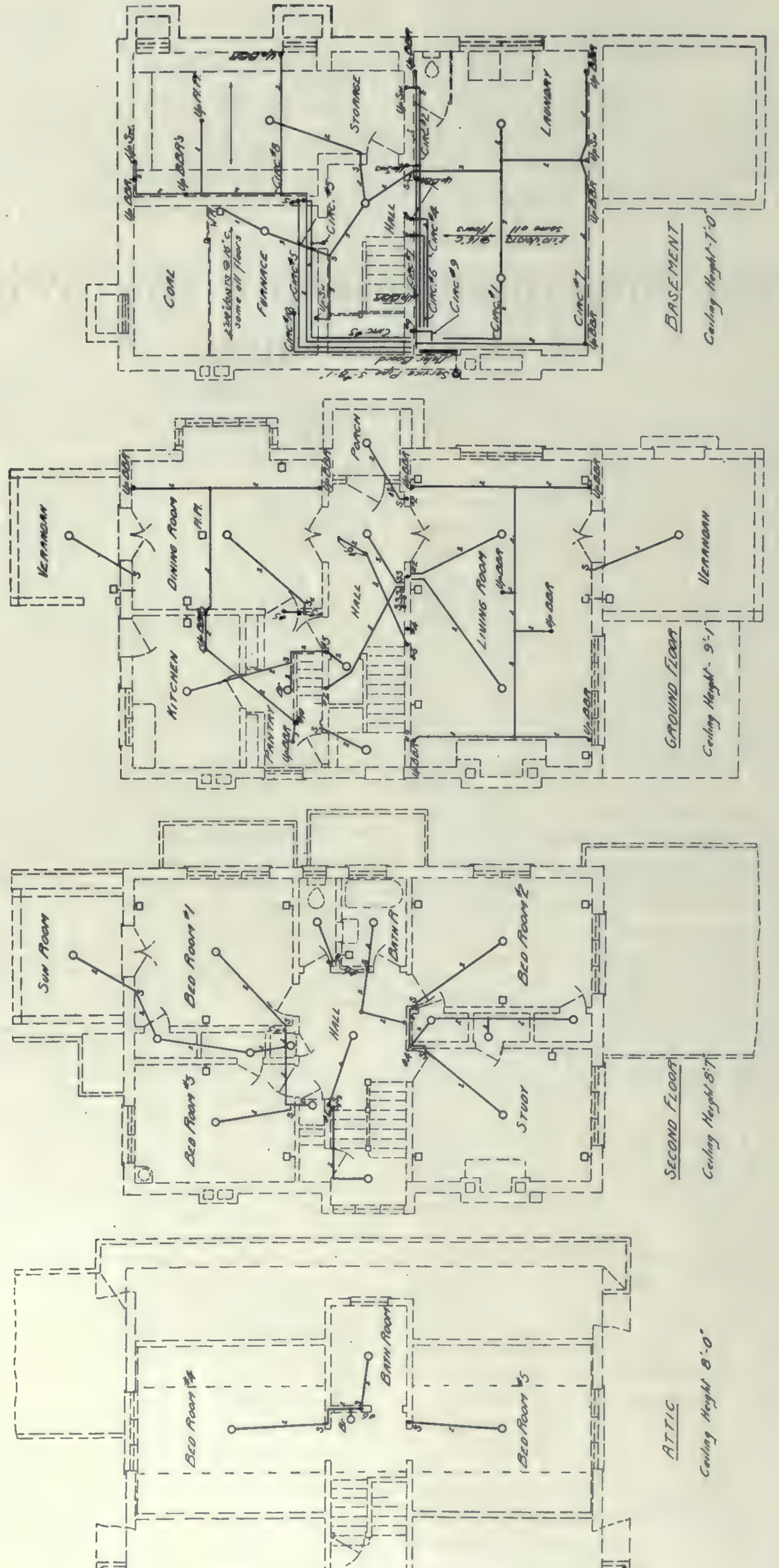
(4) Switch controls—The arrangement of switches in the main halls would appear to be especially convenient without over-elaboration. It will be noted that the lamp in the lower hall is controlled by three switches consisting of the usual two three-ways, one upstairs and one down, and an extra three-way downstairs placed in series with the other two and which acts as a selective switch. This makes possible the use of either a small light or a brilliant light as desired, a small lamp being considered sufficient in most halls the greater part of the time. Three-way switches are not installed to control the attic hall light though this is a convenience many householders would add.

The dining room light is controlled by a two point electrolier switch which admits of low light being used for setting and clearing the table. The rear entrance light is operated from the same switch as the basement hall, it being considered that the former will rarely be needed except when going down cellar and also that it will serve as a pilot to show when the basement light has been left burning. The intermediate landing light is also controlled with the upper hall since this will be a small wattage lamp and is generally needed when the upper hall is needed. Electrolier switches for the living room, though not installed in this plan, would probably be considered essential in the average case as they would make possible better general control of the illumination as, for example, when a number of localized lamps are being lighted from the baseboard receptacles and the full ceiling illumination is not required.

(5) The service is made heavy enough to stand the addition of an electric range. Though in this particular case the wires have not been installed this is only because their installation at a later date will be an exceedingly simple matter.

(6) Ironing outlets—In the back verandah and in the kitchen where ironing is most likely to be done, outlets have been placed high (6 ft. from floor) so that the ironing cord will not interfere with the work. These outlets are equally valuable for any other apparatus. We believe this is an important feature for the hanging cord so often installed in the ceiling is unsightly and does not admit of an absolute uniformity of base receptacle and plug throughout the building—a very important consideration. Individual requirements may demand a similar outlet in the laundry.

(7) Baseboard receptacles—A liberal number of baseboard receptacles are installed at convenient places. These will carry lamps, toasters, water-heaters and, above all, small electric heaters for spring and autumn use before the furnace is operating. A receptacle has been placed on the front verandah as this, if windowed, is most likely to be the place where an afternoon tea or a lazy breakfast will be served. The floor plug in the dining room is also calculated to supply a sufficient number of electric utensils to cook a small meal. The plan suggested is to connect a



Model wiring diagram, for illumination purposes, of a typical residence of average dimensions. (Also see specifications.)

plug in the floor with two or more flush plugs at convenient points in the table. The unsightly appearance of a number of cables hanging from your electrolier is thus avoided. The floor contact also is a permanent one and need only be removed in case the table is to be moved a considerable distance. The two additional baseboard outlets at the sideboard and buffet will admit either of decorative lighting or frying operations which might spoil the table linen.

(8) It will be noted that no provision is made in the hall for the operation of an electric sweeper. It may be contended that the liberal distribution of baseboard outlets in the various rooms would serve this purpose, but we believe it would be better to have a separate power outlet for each hall so that the stairways especially may be reached. This is particularly true of the upper flat where baseboard outlets in the different rooms have not been specified. A hall outlet will, in this case, serve to operate a vacuum cleaner at any point on this flat. It may be contended that in the strictly modern house a stationary vacuum cleaner should be installed, but we believe it is open to question whether a house of the size represented here would be justified in including what may yet be considered as something of a luxury. Much will depend, of course, on the method of furnishing to be adopted. With the modern fairly general unpopularity of carpets and their replacements by small rugs the necessity of the large vacuum cleaner is not so apparent.

(9) No mention is made in the specifications of wiring for bells or annunciators, but this is a matter about which individual tastes differ very widely. In the particular house under discussion we have been given to understand that the front door is connected with one bell and the back door with another; also that the dining room and living room are connected to a (the same) buzzer. In a house of this size upstairs bells hardly seem to be necessary though some householders prefer one push button at least upstairs, which might, in this case, be connected with the front door bell. In the dining room connection is made with a push button in the table through a floor outlet, and a push button in the living room is so located that it is easily accessible from the front veranda. Again it is a matter of individual taste whether these bells should be operated off batteries or a transformer. The strictly modern installation would use the transformer, but where small economies are a consideration it is possible the batteries will be favored.

SPECIFICATIONS

These specifications are intended to cover the supply of all necessary material and labor for the installation of a complete wiring system for lighting, etc., in the new residence for ... ... Toronto.

Working Conditions

1. House is built and roofed but not finished. Electrical work may be started immediately.

2. House is of standard brick construction.

Plans

Plan No. C-38 shows the "Wiring Plan of Residence." and shall be considered as forming an integral part of these specifications.

Circuits are indicated by single heavy lines, the number of wires in each run being marked by small numbers.

In all cases, circuits are located between the ceiling of the floor, on which they are shown, and the floor above.

Detail Specifications

1. Install standard service pipe in rear of house, as shown, same to consist of three No. 8 wires and 1-in. conduit.

2. Install meter board 3 ft. wide by 2 ft. high covered with a clear sheet of ¼-in. asbestos, painted black.

3. On meter board install one 3 p.s.t., 250 volt, 60 amp. knife switch and five 3 to 2 wire double branch fuse blocks with fuses and make all necessary connections ready for meter.

4. Install 10 branch circuits throughout the house as shown on the plan and detailed in the following summary:

Circuit Summary

Circ. No. Location	Ceiling Outlets	Bracket Outlets	Base Board Outlets	Switches	Watts	Side Service
1. Basement						
Laundry	2	..	..	1	..	R
Verandah .. .	1	..	..	1		
Hall	1	..	..			
Rear Entrance.	1	..	..	1	440	
Storage	1	..	..	1		
Furnace	1	1 W.R.	..	1		
2. Ground Floor						
Living Room.	2	..	..	2		L
Porch	1	..	..	1		
Lower Hall. .	1	..	..	2 (3w) 1 (El)	460	
Upper Hall ..	1					
Landing	1	..	..	2 (3w)		
3. Ground Floor						
Dining Room.	1	..	..	1 (El)		R
Coat Room ..	..	1	..	..		
Kitchen	1	..	..	1	400	
Pantry	..	1	..	..		
4. Second Floor						
Study	1	..	..	1		L
Bedroom No. 2	1	..	..	1	440	
Closets	..	3	..	..		
5. Second Floor						
Bedroom No. 1	1	..	..	1		R
Bedroom No. 3	1	..	..	1	460	
Closets	..	4	..	.		
Sun Room ...	1	..	..	1		
6. 2nd and 3rd Flrs.						L
Bath Room ..	1	..	1	1		
Toilet	1	..	..	1		
Bath Room ..	1	..	..	1	360	
Upper Hall ..	..	1	..	..		
Bedroom No. 4	1	..	..	1		
Bedroom No. 5	1	..	..	1		
7. Ground Floor						R
Living Room.	1	..	6	..	420	
Verandah .. .	..	..	1	..		
8. Ground Floor						L
Kitchen	..	..	1	.		
Dining Room.	..	..	2 (1Fl.Pl.)	..		
Verandah	1	..	1	1	360	
9. Second Floor						L
Study	..	..	3	..		
Bedroom No. 2	..	..	3	..	360	
10. Second Floor						R
Bedroom No. 3	..	..	2	..	300	
Bedroom No. 1	..	..	3	..		
Totals	26	11[1]	24[2]	26[3]	4,000[4]	

[1] 2 standard, 8 closet, 1 wall receptacle.

[2] 23 standard, 1 floor plug.

[3] 20 standard, 4 3-way, 2 electrolier.

[4] 2020 R, 1980 L.

Nature of Work

1. All work shall be standard "knob and tube" construction, in all respects of the most up-to-date practice and best workmanship.

2. All wires brought down walls of basement to switches, etc., must be run in metal moulding.

Location of Outlets

1. Ceiling outlets must be accurately located so as to bear a proper relation to decorative detail.

2. Bracket outlets in all closets to be located immediately above the centre of the doorways. (It is intended to equip these with pull receptacles).

3. Other bracket outlets in pantry and top landing to be located 5 ft. 6 in. above floor.

4. Baseboard receptacles to be mounted 6 in. above floor, except kitchen and back verandah, which are 6 ft. above floor.

5. Switch outlet to be mounted 4 ft. above floor unless special wall details require otherwise.

6. In any case where the direction of door swing is reversed from that shown on the plan, the switch must be changed to the opposite side correspondingly.

7. Switch outlets located on any panelled wall must be carefully centered.

Control

1. All switches indicated on the plan will be of a standard single pole type controlling one outlet only, with the following exceptions:

(1) Both laundry outlets to be controlled together by the same switch.

(2) Rear entrance and basement hall to be controlled together by the same switch at pantry door.

(3) Main hall to be controlled by a pair of 3-way switches in lower and upper halls and also with a single button, 3-way switch serving as an electrolier switch.

(4) Upper hall and intermediate landing to be connected in parallel and controlled together by a pair of 3-way switches in lower and upper halls.

(5) Dining room to have a 2-circuit electrolier switch.

Fittings

1. Switches.

(1) Basement switches to be rotary snap switches of approved type.

(2) All other switches to be push button switches of best quality Perkins or equivalent.

(3) Electrolier switch for hall to be a single button 3-way push switch, Perkins Type 0 No. 2458 or equivalent.

(4) Electrolier switch for dining room to be single button, 2 circuit push switch, Perkins Type 0 No. 2460 or equivalent.

2. Switch Plates.

(1) All switch plates to be nickle finish unless otherwise required to agree with room hardware.

(2) Upper hall plate to be standard 2 gang plate.

(3) Lower hall plate to be a single plate providing for 4 two-button switches and one single button switch, Perkins No. 3655 or equivalent.

3. Baseboard Receptacles.

(1) All baseboard receptacles to be uniform and of best quality Diamond H or equivalent.

(2) No plugs to be supplied.

(3) Finish of face plates to agree with other hardware of room.

1. The "General Conditions" attached herewith shall be considered as forming an integral part of these specifications.

2. All materials and workmanship shall conform to the requirements of the Canadian Fire Underwriters' Association and their certificate furnished at the completion of the work.

General Conditions

1. These General Conditions shall be considered as forming an integral part of any specification to which they may be attached and shall be absolutely binding in carrying out any cotnract awarded in accordance with such specifications.

2. The following interpretations shall be taken of terms used throughout the specifications:

The Proprietor means the party or parties who own the building or properties in which the contract is to be fulfilled. In this case ... ...

The Contractor means the party or parties to whom any contract may be let on the basis of these specifications.

The Architect means the architect or firm of architects under whose charge the building work is being carried on and who is exercising supervision over any or all trades which may be doing their work at the same time as the work called for under these specifications. In this case ... ...

The Engineers mean the engineers who have drawn up these specifications and under whose supervision any contract awarded on the basis of such specifications must be carried out, namely Messrs. Ewart & Jacob.

3. The contractor (unless otherwise specified) shall provide all materials, workmanship, plant, scaffolding, carriages, freightage and every other matter that may be required for the proper performance and completion of the work and the whole of which are to be the best of their several kinds.

4. The plans accompanying these specifications shall be considered an integral part of the same. Specifications and accompanying plans are intended to co-operate, so that any work shown on the plans and not mentioned in these specifications, or vice versa, is to be executed the same as if set forth by the plans and mentioned in these specifications.

5. Should any drawings or figures be omitted in the plans and details, which are necessary to a clear, comprehensive understanding, or should any error appear in either plans or specifications, it shall be the duty of the contractor to notify the engineers in writing of such omission or error before submitting tender and in no case proceed in uncertainty with the work.

6. If in the opinion of the contractor a change of plans or specifications should be made for the proper completion of the work and if such change alters in any way the original amount of the tender, the contractor must notify the engineers and submit price in writing for approval before starting the work, otherwise the engineers will not recognize any change in plans or specifications and no claim for extra payment will be allowed.

7. The plans accompanying these specifications are made as accurate as possible, but absolute accuracy of dimensions cannot be guaranteed. No claim for extra payment on account of difference of actual and estimated dimensions shall be allowed, unless such difference arises through alteration of building plans by the architect, or unless such difference shall be greater in amount than ten per centum in each case. On all plans figured dimensions are to be taken in preference to measurement by scale and drawings on a large scale are to be taken in preference to those on a small scale.

8. On all plans, the correct size, location and nature of all walls, partitions or obstructures of any kind are indicated as accurately as possible. If any additional obstacles are encountered the contractor must make good all work through or around such obstacles the same as if they had been originally indicated and no extra claim shall be allowed on account of such obstacles.

9. The contractor shall at his own cost make good any defects, settlements, shrinkages, burn-outs, grounds or other faults in his work, arising from defective or improper materials, which may appear within twelve months after the completion of the contract.

10. The engineers reserve the right to reject any and all materials which, in their opinion, are unsuitable for the proper completion of the work, or not in accordance with these specifications or accompanying plans. Such rejected mater-

ials must be removed from the premises forthwith, and if used after such rejection the contractor shall, at his own cost, tear down such materials and replace same with approved materials.

11. Successful contractor shall be required to sign the specifications and accompanying plans as well as revised contract form in which shall be stated manner of payment, time limit, amount of tender, etc.

12. The proprietor reserves the right to accept or reject any or all bids presented in determining to whom said contract will be awarded. The tenderer's reputation, as well as the amount of his proposal, will be considered and the contract made in accordance therewith.

13. The contractor will notify the engineers in writing when his contract is completed. This dated letter will be necessary to obtain his final certificate, which will be issued within thirty days after notification, if the engineers, on inspecting the work, consider the same complete.

Personal Mention

Mr. Willis Chipman, consulting engineer, Toronto, will report on several electric power schemes for the city of Edmonton.

Mr. D. F. McLeod, formerly City Engineer of New Glasgow, N.S., has been appointed City Manager of Lakefield, Fla. Mr. McLeod graduated from Cornell University in 1907.

Mr. Clarence W. Noble, general sales agent, Toronto, has left his headquarters in the east for a business trip to Portland, Ore., and Western Canadian cities. He will be absent three or four weeks.

Mr. J. B. Carswell, Toronto, a Contributor to This Issue

Mr. J. B. Carswell, the author of an article on the constructional features of the Royal Bank Building, Toronto, published in this issue, hails from Paisley, Scotland. He graduated from Glasgow University with the degree of B.Sc. and served his apprenticeship as a civil engineer with Mr. J. B. Brodie, a well-known practitioner in Glasgow. Coming to Canada, he was employed for some time on the engineering staff of the G. T. R. His experience in constructional work has been wide and practical, embracing both the architectural and the contracting side. At present he is the Toronto representative for Messrs. Ross & Macdonald, the Montreal architects. With the Royal Bank and the Central Technical School, both Toronto projects, under his supervision he has charge of two of the most important building undertakings in Canada at the present time. Mr. Carswell is an Associate Member of the Institution of Civil Engineers.

Mr. J. B. Carswell.

Another Contributor—Mr. A. D. Greer, Vancouver

Mr. A. D. Creer, Mem. Can. Soc. C. E., A. M. I. C. E., is Chief Engineer of the Vancouver and District Joint Sewerage and Drainage Board, an account of whose initial constructional operations appears in this issue. Educated at Yorkshire College, Leeds (Eng.), he served articles with his father, Mr. A. Creer, who, at that time, was City Engineer of York. Later, he took a position on the staff of the late Mr. James Mansergh, F. R. S., with whom he was associated for a period of fourteen years. Mr. Mansergh, it will be recalled, successfully carried out such immense schemes as the Birmingham (Eng.), waterworks (a 35-million-dollar undertaking), the Colombo (Ceylon) and Melbourne (Australia) sewerage systems and many other large waterworks and sewerage projects in different parts of the world. Coming to Canada in 1912, Mr. Creer became identified with Mr. R. S. Lea, consulting engineer, of Montreal, and was personally responsible for the surveys, estimates and designs embodied in the report of Mr. Lea dealing with the comprehensive joint sewer system for Greater Vancouver. When the Vancouver and District Joint Sewerage and Drainage Board came into existence, in August, 1913, Mr. Creer's valuable services in his capacity as assistant to Mr. Lea were given the highest commendation and he was appointed Engineer-in-charge of all works undertaken by the Board.

Mr. A. D. Creer.

Mr. C. J. Gibson has been appointed Town Engineer of Bowmanville, Ont.

Mr. R. C. Harris has been appointed Resident Engineer of the Alberta Division of the Canadian Pacific Railway at Calgary.

Mr. D. H. Martin is Chief Engineer for Messrs. Jas. Corbett & Sons, Limited, sub-contractors on Section 5 of the Welland Canal.

Mr. J. H. Clark, a member of the staff of Mr. R. E. Speakman, City Engineer, has been appointed Purchasing Agent for Brandon.

Mr. R. L. Dobbin has been appointed water-works superintendent for the Peterborough Utilities Commission, Peterborough, Ont. Mr. Dobbin was formerly resident engineer on the Moose Jaw water supply for two years during construction. He was also with the city of Moose Jaw in the water-works department.

Mr. R. L. Haycock, has succeeded—temporarily at least —Mr. A. N. Beer in charge of the Water-Works and Sewerage Department at Ottawa.

Mr. W. R. Sinclair, a well-known railroad and general contractor, of Winnipeg, died recently, aged 67. The deceased gentleman was a native of Scotland.

Mr. J. T. Brown has been appointed Resident Engineer and Superintendent of Bridges and Buildings for the Canadian Pacific Railway at Cranbrook, B.C.

Mr. J. D. Evans, Chief Engineer of the Central Ontario Railway, has been appointed Division Engineer of the Ottawa Division of the Canadian Northern Railway.

Mr. D. H. Martin, division engineer of the Pittsburgh & Shawmut Railroad, has been made chief engineer of the new Welland ship canal, with office at Allanburg, Ont.

Mr. R. W. Brock's New Appointment

Mr. R. W. Brock, who for some years has been a contributor to the Contract Record and Engineering Review, has resigned his position as Director of the Geological Survey and Deputy Minister of Mines, at Ottawa, to accept an appointment as head of the Applied Science Department of the University of British Columbia, which is now being established. A native of Perth, Ont., Mr. Brock obtained his undergraduate training at the University of Toronto and Queen's University, and took a post-graduate course at Heidelberg, Germany. He commenced geological survey work in Northern Ontario in 1891 and later had charge of important investigations in the British Columbia field. Such was his application that he came to be regarded as one of the leading Canadian authorities on economic geology. In 1902 he was appointed Professor of Geology in the School of Mines at Kingston, and he retained charge of the Department of Geology of this school and at Queen's University until his appointment as Director of the Survey in 1907.

Mr. R. W. Brock.

Mr. R. A. Baldwin has been appointed Engineer of Maintenance of Way of the Ontario Grand division of the Canadian Northern Railway, Eastern lines, with headquarters at Toronto, Ont.

It is interesting to recall the fact that both General Joffre, Commander-in-Chief of the French Army, and Lord Kitchener, the new head of the English War Office, are engineers by education and experience, as well as soldiers. General Joffre is a graduate of the Ecole Polytechnique, Paris, and obtained much of his early experience in the engineering corps, having had charge of railway construction in West Africa and harbor work in Madagascar. Lord Kitchener is a graduate of the Royal Military Academy, at Woolwich, and entered the Royal Engineers in 1871. Between 1874 and 1882 he had charge of extensive survey work in Palestine and the Island of Cyprus.

Mr. Arnold Pfau, one of the foremost designers of hydraulic turbines, has been detained in Switzerland, where he is eligible for army service. Mr. Pfau is consulting engineer to the Allis-Chalmers Company, Milwaukee, Wis.

Mr. Thomas Turnbull has been appointed assistant Chief Engineer of the Canadian Northern Railway, with headquarters in Winnipeg. For the last four years Mr. Turnbull has been with the Canadian Pacific Railway in the West, and with the Hudson Bay Railway.

Mr. T. Aird Murray, Consulting Engineer to the Province of Saskatchewan, accompanied by Dr. Seymour, Commissioner of Public Health, has been making a tour of inspection of the sewage disposal works throughout the province. He has inspected the plants at Indian Head, Estevan, Weyburn, Yorkton and other places.

Obituary

Mr. John Middleton, who was a member of a Canadian Northern Survey party, fell a distance of 70 feet from a ledge of rock near Lytton, B.C., and was killed.

Mr. Murdock Lloyd, a mining engineer who belonged to Toronto, died from injuries received in a boiler explosion at the Tough Oaks Mines, Swastika, Ont., recently.

H. W. Anthes, Managing Director of the Anthes Foundry, Limited, Toronto and Winnipeg, died recently. The late Mr. Anthes was born in Wilmot Township, Waterloo County, Ont., in 1851. Both his parents were natives of the Province of Alsace, Lorraine, which is figuring so prominently in the present war. In 1889 he established the Toronto Foundry Company, Limited, the name being changed subsequently to the Anthes Foundry, Limited.

In July last a fresh break occurred in the Montreal water conduit, which necessitated prompt measures being taken to repair the damage by means of a band of concrete built around the part affected. Mr. Henry R. Lordly reported upon the effects of blasting upon the conduit, and following this Mr. Rudolph Hering, of Hering & Fuller, the New York consulting engineers, has submitted a report to the Board of Control to the effect that, in view of Mr. Lordly's experiments, there is no danger of proceeding with the rock excavation within certain limitations. In Mr. Hering's opinion there is no necessity for constructing a new conduit, as, with certain exceptions, the conduit is in very good condition. The break which occurred last July was not caused by normal conditions either within or adjoining the conduit, and in Mr. Hering's view it could be due only to an explosion which took place inside of the conduit where the break occurred.

The 16th Annual Convention of the Ontario Municipal Association is now being held at the City Hall, Toronto, the dates of the meeting being September 2-3. The programme is an attractive one and includes papers upon many phases of municipal administration. Mr. W. A. McLean, Chief Engineer of Highways for the Province, is scheduled to deliver a paper, "The Cost of Roads." The subject of the paper to be given by Mr. S. H. Kent, City Clerk of Hamilton, is "A Government Minister and a Department of Municipal Affairs." The President of the Association is Mr. J. G. Richter, of London, Ont.

MAINLY CONSTRUCTIONAL

EAST and WEST — FROM COAST to COAST

EASTERN CANADA

The Board of Trade at Fort William have recommended to the city a site for the C. N. R.'s proposed station buildings.

Lime & Agencies is the name of a new Toronto concern, capitalized at $40,000, which will engage in the manufacture of brick, terra cotta, and sewer pipe.

Tenders are now being called (close September 3) for a new town hall at Lachine, Que. The architect is Mr. D. Viau, of Montreal. The cost is estimated at $100,000.

Twenty-three miles of new pavements have been laid in the City of Montreal this season to date. This brings the total of paved streets up to 132 miles—out of a total mileage of 480.

It is expected that the plant of the Canada Wire Nail Company in West St. John, N.B., will be in operation in a week or so. All the machines have been set up and the plant is prepared for a big output.

There is no truth in the rumor that the Dominion Steel Company has closed down its plant at Sydney, N.S. From the General Manager, Mr. J. H. Plummer, comes word that despite a reduction in the staff there are still 1,600 men at work.

From Grand Falls, N.B., comes a report that the new bridge across the river below the Falls has been completed and formally opened for traffic. This structure takes the place of an old suspension bridge which has been in use for upwards of fifty years.

The Anglo-Canadian Construction Company, Limited, North Bay, Ont., has been incorporated with a capital of $100,000. The new firm will carry on a general contracting business. Mr. H. R. Miles, civil engineer, North Bay, is interested in the enterprise.

A $20,000 addition to the factory of the Remington Arms Company, at Windsor, is being made by Messrs. Wells & Gray, of Toronto, architects and general contractors. The addition is to be one-storey high, of steel, reinforced concrete and brick construction.

The Dominion Government is considering the matter of building an addition to its elevator, situated between Fort William and Port Arthur. The present storage capacity of the elevator is 3,250,000 bushels. The proposed addition will probably double this capacity.

At Ottawa, Ont., operations on the stores and apartments which are being erected on Rideau street for Donald Fraser have reached the third storey. The building is of solid brick construction and will cost $180,000. The architects are Messrs. Horwood, Taylor & Horwood.

The Montreal firm of Messrs. Barott, Blackader & Webster, are now associated with Mr. P. A. Westover, of Philadelphia, in the architectural work for the new theatre which is to be erected at the corner of St. Denis and St. Catherine Street, Montreal, by the Imperial Theatre Company.

The foundation work has been completed for the office building which the National Trust Company proposes to erect in Montreal at a cost of $150,000. The architect is Mr. Kenneth G. Rea and the general contractors are Messrs. Norcross Brothers, New Birks Building, Montreal.

Mr. R. C. Harris, the Toronto Works Commissioner, has submitted to the Board of Control a recommendation that gold watches suitably inscribed be presented to the members of the Works Department who were identified with the sewer gas tragedy in which a member of the staff, Mr. Robert G. Strathern, lost his life.

In connection with the New Toronto water-works scheme, it is of interest to note that operations have been commenced by Mr. J. E. Curley, who is the contractor for the 18-in. intake pipe and mains. The pumping station and other work will be commenced shortly and it is expected that the whole scheme will be completed by the end of the fall.

The city authorities at Montreal claim overcharges on the Notre Dame de Grace sewer work, and action to recover the amount from the contractors will be taken. It is claimed that clay and loose boulders were charged for at the rate of solid rock. The contractors will contest the action and promise to raise some interesting points as to classification.

The University of New Brunswick is now holding its annual engineering camp at Sussex, N.B. Professor John A. Stiles, Dean of Engineering, is in charge, with Mr. G. T. Feeney as Assistant. The period of encampment is from August 24 to September 12. The students engage in practical work in railway construction, stream measurement, surveys, and so on.

St. John, N.B., has taken advantage of the New Brunswick City Planning Act, and a Commission has been appointed. It may be some little time before the provisions of the Act are made effective, but when the new Commission gets down to work it will see that there is the minimum delay in applying the Act to local conditions. The desirability of having regulations of this character is fully recognized by the City Council.

In the field of projected work, interest centres around the construction of the Don Section of the Bloor Street Viaduct tenders for which close October 5. Tenders have been asked for a bridge consisting of five steel arch spans with piers and approaches, the width being 86 ft. and the length approximately 1,618 ft. Specifications and plans are open for inspection at Toronto, London, Eng., Chicago, and New York. Contractors tendering on reinforced concrete construction are submitting plans and specifications at their own expense.

From Hamilton comes the report that everything is in readiness for an immediate start upon the erection of the Royal Connaught Hotel. At a Directors' meeting recently, Sir John Gibson, President, stated that the building would cost perhaps $100,000 more than the early estimate of $1,000,000. The structure will be twelve storeys high. The steel contracts have been let and satisfactory bulk tenders are stated to have been secured. Mr. H. L. Frost, Vice-President of the company which is promoting the hotel, emphasizes the fact that the business interests of Hamilton cannot afford to have the construction of the hotel postponed. He considers that it is most desirable for the work to proceed without delay. "Hamilton," he says "has goods to sell which will be required all over the world, and with a number of European countries out of the export business, it will not be long before there is an active demand for nearly all lines. The $1,000,000 Connaught Hotel is a prime necessity at Hamilton."

WESTERN CANADA

The latest addition to the modern office buildings in the City of Vancouver is the fifteen-storey Standard Bank Building, which has a frontage of 78 ft. on Hastings street and 120 ft. on Richards street.

A branch of the Canadian Society of Civil Engineers has been established in Edmonton, with headquarters at the University of Alberta. Professor W. Muir Edwards has been elected Chairman, and Mr. L. B. Elliott, Secretary-Treasurer.

At Winnipeg, two apartment blocks are under construction at Fort Rouge. The owner and general contractor is Mr. P. MacKissock, and the architect is Mr. W. B. MacKissock, Winnipeg. The building will be of brick construction and will cost $120,000.

Operations are about to commence on the new post office at Saskatoon, which is to be erected at a cost of $100,000. The construction will be of brick and stone. The work will be under the direction of the Department of Public Works, whose District Engineer for Saskatchewan is Mr. L. R. Voligny.

At Winnipeg, operations are in progress on the Grain Exchange, which the Traders' Building Association is erecting at a cost of $500,000. The building will be of stone, brick and steel construction. The architects are Messrs. Jordan & Over, and the general contractors are Messrs. Carter-Halls & Aldinger.

From Saskatoon comes word that operations are being rushed on the construction of the Dominion Interior elevator. The war has had the effect of hastening work on the completion of the interior storage elevators in Western Canada, as it is hoped that these structures may play an important part in the machinery for the feeding of the allied armies.

According to a despatch from Lethbridge, a discovery of twenty-three kegs of blasting powder was made recently in the vicinity of the C. P. R. viaduct, over the Belly River. Shortly afterwards the Mounted Police arrested a man named Hermann Weirmeir, on his way towards the shack in which the powder was stored. A heavy guard at the bridge is now maintained.

The Eighth Annual Convention of the Western Canadian Irrigation Association was held at Penticton, B.C., from August 17th to August 19th. The meeting was attended by irrigation authorities from California, Oregon, Idaho, Washington and Utah, as well as from the Prairie Provinces and British Columbia. The Secretary of this association is Mr. Norman S. Rankin, Edmonton.

Calgary is congratulating herself on the announcement that there will be no halt in projected public work. The new government elevator, upon which some three hundred men will be employed, will be rushed to completion. This contract will involve eighteen months' work. The war has not injured Calgary's prospects of getting her proposed batch of new Federal buildings. The work on the new post-office alone will employ large numbers of men. In the industrial field, plans are being prepared for the proposed building of Messrs. Gutta Percha & Rubber, Limited.

In the last bulletin issued by the Canadian Society of Civil Engineers, it is stated that at the request of certain members the alleged employment of alien engineers in the Government service in Calgary has been looked into, but the matter was not found to be one in connection with which the Council could make representations. The Council has also had under consideration letters from certain City Engineers who allege unfair treatment by the employers. In this case also it was not found practicable to take any action.

Coming Events

The 21st session of the International Irrigation Congress is to be held at Calgary from October 5-9.

The fourth American Road Congress is to be held at Atlanta, Ga., November 9-13. The Executive Secretary is Mr. I. S. Pennybacker, Colorado Building, Washington.

The Royal Architectural Institute of Canada will hold their seventh annual meeting at Quebec, September 21-22. Mr. Alcide Chausse, of Montreal, is the Honorary Secretary.

The Seventh General Annual Assembly of the Royal Architectural Institute of Canada is to be held at Quebec, September 21-22 next. The president is Mr. J. H. G. Russell, of Winnipeg.

The annual convention of the Canadian Health Association will be held in Fort William, September 10-12. The members include medical men, engineers and public health workers from coast to coast.

The American Road Builders' Association will hold their Eleventh Annual Convention and Exhibition in Chicago, December 14-18. The Secretary is Mr. E. L. Powers, 150 Nassau Street, New York.

Business Notes

The Harland Engineering Company, power engineers and contractors, have removed from 26 Victoria Square to larger offices at 102 St. Antoine street, Montreal.

Messrs. Eberhard-Wood Manufacturing Company, manufacturers of ornamental and general iron work, held their annual excursion at Grimsby Beach, Ont., on Saturday, August 15. The party consisted of about one hundred. An attractive programme of sports was carried out.

The Ebsary Fireproofing Company (Confederation Life Building, Toronto) have awarded the contract for their new building at Caledonia, where the manufacture of their gypsum fireproofing materials will be carried on. Heretofore the materials have been brought in from the American factory.

A fire occurred recently at the premises of the Kerr Engine Company, Limited, Walkerville, Ont., but assurance is forthcoming from the firm that nothing was lost or damaged which will interfere with their filling orders for brass or iron valves, hydrants or other of the lines listed in their catalogue No. 5, issued recently. Such patterns as were lost were of engines, pumps and mill machinery.

The Toronto office of Herbert Morris Crane & Hoist Company, Limited, inform us that their English company has received contracts from the British War Office for a large quantity of lifting and shifting machinery. In order to prevent delay in the delivery of the goods, the cases are all tagged with labels bearing the name of the firm and the words, in large red capitals, "On War Service." Recent developments have shown the wisdom of the company's policy in carrying large stocks of this machinery. The Toronto office, of which Mr. Malcolm Meldrum is General Manager, is equipped to supply any demand. The Canadian branch has several miles of chain in stock and can make immediate delivery of any chain block up to thirty tons capacity and with any height of lift required. A large number of hand-operated, overhead travelling cranes are on hand.

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Alphabetical Index of Advertisers Page 18

Vol. 28 September 9, 1914 No. 36

Principal Contents

A Panacea for Pessimism—Work ... 1123-4
Our Contemporaries on the War Crisis ... 1124-6
The War and the British Engineer.
The War and Local Authorities.
Clayworkers in War Time.
The Manufacturer's Opportunity.
Ottawa River Water Supply ... 1126-7
The C. P. R. Double-Track Tunnel through Mount Macdonald, B.C. ... 1127
Wall and Column Footings in the Design of Masonry Structures ... 1128-30
Dangers in Bank-Run Material ... 1130
Methods of Sampling Sewage and Other Liquids. 1131-4
By G. Bertram Kershaw.
The Prevention of the Sub-Crust Movement in Roads ... 1135
Constructional Details of the Concrete House ... 1136-8
The Efficient Design of Small Waterworks Systems. 1139-41
High Standard of Exhibits at Toronto—The Thirty-Sixth Annual Canadian National Exhibition ... 1142-4
Clamps for Splicing Reinforcements ... 1144
Canada the Chief Source of Asbestos Supply ... 1145
Puddling or Ramming Concrete after Placing ... 1145
Clay and Shale Deposits of the Western Provinces. 1146-8
Personal Mention ... 1148
Constructional News and Industrial Notes ... 1149-50

The Panacea for Pessimism—Work

Sound Doctrine of the British Press

IN considering the destructive element in the situation brought about by the present calamitous war, and in making rightful provision for the dependants of those engaged in active service, we must not overlook our responsibilities from the constructive viewpoint, having regard to the maintenance of such activity at home as will preserve our business equilibrium and enable us to rise to the opportunities which will undoubtedly present themselves when the word goes forth to cease fire.

It is gratifying to note that the measure of responsibility likely to be recognized by governing authorities in the old country finds active support and encouragement in the representative technical journals of Great Britain. We have all come to a full appreciation of the ties which bind Canada to the mother country and so it is interesting to follow the trend of opinion in the constructional world there, as voiced by our contemporaries.

Of the many articles dealing with the war and its effect upon British trade that we have read in English journals, we are particularly impressed with the observations of "The Engineer," "The Sanitary Record and Municipal Engineering," and "The British Clayworker," which are reproduced in whole or in part elsewhere in this issue. Generally, we believe that these articles will make interesting and suggestive reading, but the manner in which certain principles are laid down is deserving of special emphasis as embodying the law and the prophets. We commend the following paragraphs, which embrace sound economics and good common sense:

> "Profits decline with the pay sheet and decline in a ratio that is altogether disproportionately great as compared with the decline in the pay sheet. . . . . To enable the masters to retain their men as far as possible, the men, by working at lower rates for the time being, must help to spread the wages over a larger section of the working community."
>
> "The policy of inter-purchasing between manufacturers in this country must be developed."
>
> "Our manufacturers, with all the fortitude in their power, must face the difficulties of a temporarily collapsed trade, strong in the conviction that when the war is over their position will be far stronger than it has ever been."
>
> "Owners of brick works . . . . can turn the present occasion to some good account by overhauling their kilns, machinery, plant and works generally, in order to see in what manner their business can be conducted on better lines. Indeed, even under normal business conditions, a pause in the year's work might well be available for this purpose."
>
> "Upon the engineers of municipal authorities the responsibility will chiefly lie of formulating schemes of improvement. Sufficiency of work can be found if every local authority will rise to its task."

The only panacea for pessimism is work. So long as we attend to business and remain a nation of optimists and workers we need have little apprehension regarding the internal stability of the Empire. It is more than likely that we shall be called upon to make sacrifices, but our commercial integrity and business stability can be maintained through all sacrifice if a sane, conservative policy of confidence and co-operation be put into effect. After the present enemies of the Empire are vanquished on the field of battle it will remain for us to make the victory complete in the industrial field. Ultimately it will be shown that "commerce, not arms, is the real ruler of the world."

In the present great crisis of the world's history each one of us has a well-defined duty. Let us meet it to-day and await the dawn of opportunity on the morrow.

Our Contemporaries on the War Crisis

Suggestive and Significant Utterances of the British Technical Press—Editorial Observations Characterized by a Sane Confidence and Appreciation of Individual Duty—The Part of Municipal Authorities Outlined

The War and the British Engineer

"The Engineer" (London, Eng.)

THE colossal struggle which has been suddenly thrust upon Europe has, naturally enough, dislocated every phase of life. Politics, as we usually understand them, finance, food, travel, trade and industry, all for the moment are dependent on the evolution of the vast catastrophe which Britain, France, Russia, Belgium, Servia, Montenegro, Austria, and Germany now have to face, and in which half a dozen other countries are becoming involved.

Among the industries of this country which will necessarily be seriously affected is, without question, engineering, that industry on which the country relies alike for its machines of war and of peace, from a battleship to a barbed wire entanglement on the one hand, and from a pumping station to a plough-share on the other. We have not to deal with the rights and wrongs of the war in this journal. We have not to argue whether or not war was inevitable, or whether it is preferable to have it now or later on. We have not to deal with the excitement and horrors which already are on us, or to harp on the blood which has been and will be shed, of the glory and the misery of the field of battle. The war is here, an actual fact, and whatever the outcome may be, we have to face it and carry it through. There are four cardinal elements that make for success or failure, leaving out of the question the righteousness of the cause. These are the resources of the country concerned, the statesmen who control the policy, the officers and men engaged, and the material used. We, as we hope is the case with everybody in the country, have full confidence in the quality of all four of these essentials. Never was British engineering at so high a pitch of perfection as it is to-day. Never have our Navy and Army been so thoroughly and efficiently equipped with everything that engineering brains and skill could produce for their requirements. Our splendid firms have done everything that human power could do to ensure our success at war, and we await in patience and with confidence the results of our labours now that our materials are to be put to the most severe practical test that the world has ever seen.

We have, therefore, as manufacturers of war material, discharged our duty to our country. Now comes the question, what are we going to do for ourselves? By that we mean for our masters and our men. Our war material firms, no doubt, will be working night and day, and a considerable number of firms which do not habitually cater for this trade will take it up. It is reasonable to suppose, too, that the war will produce a sufficiency of orders in the way of certain railway, electrical, constructional, pumping, and many other types of plant which are necessary accessories to war material. War, in itself, is an enormous producer of engineering orders, and in a war so vast as this it is impossible to estimate even approximately the impetus which it will give to many of our firms which least expect any pecuniary benefit from it. But in Great Britain we have some 1,200 engineering works, large and small, to keep going, and there is no doubt that the war in itself and the purely home orders will not suffice to fill half these firms with work. What is to happen to the less fortunate works and to the hands they employ during the period when no further foreign business can be obtained, a large percentage of the existing orders cancelled, and payments for work done withheld on account of the dislocation of finance? That is the great problem which we as engineers have to face and solve. "Do not discharge your hands," say the Government and the lay journals to the employer of labour. That is obviously a right-minded doctrine to preach. It would be sound, too, were it feasible; but, alas, it is not. We wonder if those people who urge the manufacturer to keep his works running when he has nothing to make realize what the loss entailed by him would mean. A works employing a thousand men has an approximate pay sheet of £100,000 a year. Assuming that our engineering firms are willing to "make work"—that is to say, to manufacture goods without orders which there would be a reasonable chance of selling after the war—there remains the difficulty of material. We venture to hope that this difficulty will prove by no means as great as is thought by some. Coal we have in abundance, and iron and steel and other metals in certain quantities. Then again, owing to the efficiency of our Navy, it is reasonable to suppose that many of the markets from which we purchase our materials will be kept more or less open to us. But prices will in many cases be high, and it is not when such is the case that manufacturers are encouraged to run up stocks, for to be profitable and at the same time to cover the risks of delays in sale, all machinery made for stock must have every advantage in the way of cheap labour and material. But something of the sort must be done, and the trade unions, by lowering wages for the time being, must help the masters by every means in their power to accomplish it. We believe that they will do it. We are in for a period of all-round self-sacrifice, not merely in what we eat and in the manner in which we live, but, above all things, in the way we carry on our work. Those who appeal to the employer to retain his hands when he has nothing for them to do should bear in mind that no employer ever discharges his men if he can avoid doing so. The profits, as every manufacturer knows full well, decline with the pay sheet, and decline in a ratio that is altogether disproportionately great as compared with the decline in the pay sheet. Thus it is that our manufacturers are being asked to do the impossible. Moreover, they are being asked to do precisely what they would give anything to be able to do. To enable the masters to retain their men as far as possible, the men, by working at lower rates for the time being, must help to spread the wages over a larger section of the working community.

It is an ill wind indeed that is now blowing for the majority of our engineering firms—a very ill wind. There is no doubt whatever that some of them will find it difficult to weather the storm if the war is at all protracted. But like the worst of ill winds, it cannot fail to blow some good. That good will be twofold, and we firmly believe that it will far more than outbalance the sacrifices which our firms will have to make in the meantime. One of the effects of this war while it lasts will unquestionably be to cause our engineering firms to purchase much more of their materials in this country than is usually the case. They may have to pay more for them, but that cannot be helped. The makers of such materials must meet them in the matter as far as possible. Too often of late years, while preachnig the doctrine that British plant is the best, we have been inclined to buy our materials in the cheapest market. The policy of interpurchasing between manufacturers in this country so strongly advocated by the British Engineers' Association must be developed. Now is essentially the time to begin a more patriotic policy than in the past and to strain every effort to find what we want in our own country. The policy of British materials for British firms cannot, of course, be carried out in its entirety, but it can be to a much greater extent than heretofore. The second benefit which the engineering firms of this country should derive from this terrible war is, always assuming that it is carried to a successful issue, that for a long time, at all events, the air will be cleared of that unhealthy and often dishonest class of foreign trade which has been gradually eating its way into the methods of placing engineering contracts abroad. Germany is the country which has introduced and fostered this pernicious system, and we hope that the war will clear the markets of her influence for many years to come. We do not object to foreign competition on open and above-board lines; but the methods of the German manufacturers, due no doubt to the fact that they could not obtain business in a legitimate manner, have been such as to create absolutely unsound conditions which must cease when the credit of that country has been destroyed. That credit, which has been held together by a very fine thread of late years, was well on the way to disruption before the war commenced. It has snapped with a bang during the last few days, and every hour between now and the end of hostilities can only render matters worse for Germany. Meanwhile our manufacturers, with all the fortitude in their power, must face the difficulties of a temporarily collapsed trade, strong in the conviction that when the war is over their position will be far stronger than it has ever been.

From Chicago we learn that Cook County, Illinois, has opened the first building of its hospital, which upon completion will have cost $16,000,000.

The War and Local Authorities: Providing for the Aftermath

"The Sanitary Record and Municipal Engineering" (London, Eng.)

LOCAL authorities as big employers of labour are almost without exception undertaking to pay the wives of Reservists and Territorials who have been called up for service the wages their husbands would have received—less the amount received by the husband from the Government—if they had continued in their employ. We wish they could have been generous enough to pay the whole amount of their wages. It would even then have been inadequate recompense for the severance from home and the perils so many of them will have to undergo. It would, moreover, act as an inducement to others to join the auxiliary forces. All the Local Authorities have also undertaken to reinstate those of their servants will have been mobilized, in the positions they previously held. The nation cannot afford to be ungenerous, and we hope this will be stedfastly kept before the stay-at-homes. A great war cannot be carried on without terrible loss of life, frightful suffering to the maimed and wounded, and anguish and destitution to those robbed of the breadwinner. Our own Royal Family, who possess the beautiful instinct of doing the right thing at the right time, have foreseen that the war will leave a sad aftermath, and that the maimed and wounded will require to be provided for and distress to be relieved. Hence the inauguration of a National Relief Fund, towards which the Prince of Wales has appealed for subscriptions. A noble response has been already made, and a sum of not less than one million pounds will be subscribed. But this will not be enough. Scarcely a city, town, or village in the kingdom will be unaffected, and upon Local Authorities lies the urgent necessity of action. Such Authorities may mitigate the results of the dislocation of industry which will inevitably ensue by expediting schemes of public works upon which surplus labour can be utilized. Moreover, they are advised to prepare schemes in advance and where loans are required for such the Board are prepared to facilitate them.

SCHEMES WHICH CAN BE UNDERTAKEN

Upon the Engineers of Municipal Authorities the responsibility will chiefly lie of formulating such schemes. Their task will frequently be a difficult one, for whatever is undertaken should be in the nature of an improvement. The construction of or extension of sewers and sewage disposal works, the levelling of the surfaces of parks and pleasure grounds so as to make additional portions of them suitable for cricket or tennis lawns or bowling greens; the formation of lakes and children's playgrounds in such parks; the construction of new roads, the lowering of hills on roads, or the paving or strengthening of the foundations of existing roads, or the making up of private streets; the straightening of the courses or the covering over of streams running through populous districts; and the erection of cottages for the labouring classes. Any of these may be carried out to the ultimate benefit of any district, and will therefore be productive labour. Other schemes will doubtless suggest themselves to Local Authorities and their Engineers. In the more rural districts the government proposes to erect cottages for laborers and so afford some employment in such districts in co-operation with Rural Authorities and public utility societies. Sufficiency of work can be found if every Local Authority will rise to its task, and none should be found which is so bereft of generosity for the sacrifices made for the nation by its sailors and soldiers as to delay in preparing for the aftermath of the war.

The Manufacturer's Opportunity

"The Clayworker" (Indianapolis)

MANUFACTURERS and investors need not feel the least hesitation about pushing into the abandoned markets wherever they can be found. All the nations engaged in the conflict are of age. Their rulers, even though they may resent the way of the people have been curtailing the powers of royalty, are of ordinary intelligence and know what the effect will be. Those who are engaged in the embroglio have a right to pick up what has been so foolishly thrown aside. Commerce, not arms, is the real ruler of the world; but age-long race hatred, adroitly fostered by cunning rulers and a ruthless aristocracy, has finally developed a cataclysm which will shift the balance of power in Europe and so change it that it will be unrecognizable. Meanwhile, the trade built up with so much labor is destroyed.

Wherever clay products of any sort have had to compete with those made in either of the belligerent countries they virtually have the field to themselves. The course to be pursued is obvious. We may, and do, deplore what seems to all Americans a senseless conflict and a needless destruction of life and property, but this regret need not, and should not, prevent our profiting by the folly of our erstwhile competitors in numerous lines of manufacture.

Clayworkers in War Time

"The British Clayworker" (London, Eng.)

DURING the present regrettable crisis in the fate of the nations of Europe, and whilst the naval and military interests of this country are in the hands of others, British clayworkers can best help the nation by making every possible effort to find their employees enough work to feed them. Distress there must inevitably be, but the worst means of relieving it is undoubtedly charity pure and simple. It is work that should be found, both to save the workers' self-respect, and to keep the wheels of industry running as much as possible. In those cases where, with the best intentions, owners of brickworks have no option but to close down, they can turn the present occasion to some good account by overhauling their kilns, machinery, plant, and works generally, in order to see in what manner their business can be conducted on better lines. Indeed, even under normal business conditions a pause in the year's work might well be advisable for this purpose. Money saved is, we know, money earned, but many brickmakers fear to interrupt the continuity of their work, although by occasionally doing so they might by improvements save in a very short time a great deal more money than they could earn by continuing over the period allotted to stoppage.

The Government, to their great credit be it said, are acting as promptly to prevent distress as they did to prepare the fleet for service. . . . . . The general position is well summed up by the following statesmanlike notice from the First Commissioner of Works: "It appears from various enquiries addressed to the Commissioner of Works that there exists some apprehension lest unemployment should be increased in the building and other trades by suspension during the present crisis of building and engineering operations provided for in the estimates of the Office of Works recently approved by Parliament. It is, therefore, desirable to state publicly at once that it is the intention of the Commissioner of Works to proceed with all services in their charge, to employ as many men as possible to carry out such services, and to develop and expedite their building programme in any way practicable. As the Minister mainly responsible for Government building, the First Commissioner of Works would wish to take this opportunity of expressing his sincere hope that private individuals, companies, firms, and contractors will spare no effort to follow the policy of the Government in this matter, so far as circumstances admit." We are sure that clayworkers, at all events, will do their best to this end.

Ottawa River Water Supply

COMPLETE plans and specifications for the Ottawa River water system have been laid befor the Ottawa Board of Control by Messrs. Hazen & Whipple, New York. The mouth of the intake will be 500 feet out in the river. The purification plant, reservoir and other works will be placed at the junction of Scott Street and Parkdale Avenue. A reservoir with a capacity of ten million gallons, and also a smaller one, will be built. The entire works are designed to meet the requirements of the city for an average supply of twenty-five million gallons daily, but the full capacity will be thirty-five million gallons. At the Queen Street pumping station there will be provision for pumping at the rate of eighty million gallons daily, forty-four millions by water power and thirty-six millions by an electric auxiliary plant. The total pumping capacity of the several units at the low lift station will be seventy-five million gallons a day.

Apropos of the subject of waste, Mr. Fuller states that if the present enormous loss of water in Ottawa is stopped, the plant will be adequate for the needs of a city of from 250,000 to 300,000 people.

The purification plant will be similar in its general design to plants in operation at Westmount, Que., Cincinnati, Ohio, Columbus, Ohio, and New Orleans, La. It will consist of large coagulating basins, mechanical filters, and pure water reservoirs.

The plans make provision for doubling the capacity of the plant. The intake pipes will be made double the capacity of the present installation. Space is allowed in the low level station for another unit of thirty-five million gallons. Coagulating basins, filters and reservoir capacity may be added in the future when required.

Provision is made for the adaptation of certain portions of the work to the construction of the Georgian Bay Canal.

The intake crib will be built as a rock-filled timber crib up to low water level, and above that the construction will be boulder concrete. Wooden bar screens will be placed in front of the intake to exclude logs and other large material. The intake pipes will consist of

C.P.R. constructional operations on the Selkirk tunnel.

The C. P. R. Double Track Tunnel Through Mount Macdonald, B. C.

In our issue of April 8, we described the preliminary steps taken to construct the C. P. R. double track tunnel through Mount Macdonald, one of the peaks of the Selkirk Range, B.C. This will shorten the route by four miles, effect a considerable grade reduction, and enable one of the most costly sections of the system, from an operation point of view, to be abondoned. Since April the force of men has been largely added to, and great progress has been made with the scheme. An enormous amount of excavation was required to obtain the right grade for entering the tunnel at the western portal, while a large amount of filling had to be done near the point where the present line turns off. The excavation was done by means of steam shovels.

As previously explained, the contractors have adopted the system of the "pioneer" bore with a view to facilitating construction. This consists of a separate tunnel driven in a line fifty feet parallel with the course of the main passage through the mountain. The idea is to permit drillers to concentrate their activities at several different points at once instead of confining their efforts to one place, as with the usual method. Drifts are projected from the preliminary shaft in the direction of the main tunnel. At the west side of Mount Macdonald the pioneer bore enters the slope several hundred feet above the cutting. It takes a downward course for the first 300 feet on a 50 per cent. grade. Then it goes straight forward and ahead to the mapped-out course parallel with the main tunnel. The pioneer shaft at the eastern portal is now 3,000 feet into the heart of the mountain and over a thousand feet of the main tunnel has been driven. A feature of the boring operations in the soft material at the start of the main tunnel at the western end was the use of hay to knit together the earth and water which oozed out as the excavation proceeded. The hay was placed in handfuls between the wooden supports used to keep the preliminary shafts from falling in.

(Ottawa River Water Supply)

two fifty-four inch steel pipes, laid beneath the bottom of the river and surrounded completely by concrete. These pipes will be laid to the suction well in the low level pumping station from which the water will be taken by the pumps. An emergency intake will be provided in this well.

The low lift station will be a reinforced concrete structure equipped with four centrifugal pumps with capacities of thirty-five millions, eighteen millions, twelve millions and five millions in gallons daily. All pumps will be direct-connected to electric motors, and, in addition, as a precautionary measure, to a steam turbine. Provision is made in the station for the installation of another thirty-five million gallon unit.

The pipe lines from the pumping station to the purification plant, and from the purification plant to the Queen Street pumping station, will be duplicate lines of forty-eight inch steel pipe. Where the lines cross streets, railroad tracks and other points where special protection is desirable, the pipes will be surrounded by reinforced concrete.

The report describes in detail the process of filtration and the application of the chemicals. The main points of constructional interest have been outlined in this abstract. It may be of interest to know that unqualified approval of the scheme has been given by Mr. J. Waldo Smith, Chief Engineer of the New York City Waterworks.

The necessity of the establishment of a Government Department of Municipal Affairs was urged upon the delegates to the annual meeting of the Ontario Municipal Association at Toronto last week by Mayor Carter, of Guelph, and other speakers. Mr. Carter had no hesitation in saying that only five per cent. of the men elected to municipal bodies understood their business or were familiar with the conduct of municipal department.

Wall and Column Footings in the Design of Masonry Structures

FOOTINGS form an important element in the design of masonry structures. The two forms of footing most commonly used may be named the wall footing and the column footing, the former projecting laterally on the two sides of a longitudinal wall and the latter extending in four directions from the base of a column or pedestal block. It is usually assumed in the design of foundations that the earth conditions are such as to make the upward pressure on the footing uniform over its surface. Wide differences exist in methods of designing, due to differences in the assumptions made with reference to the structural action of the footing. It is not strange that these differences exist, since few or no experimental data are available which apply directly to the conditions of footings. Relatively short and deep beams and slabs under heavy uniform loads, with the supporting pressure largely concentrated at the centre of the structure, may not be expected to give the same results as have been obtained in tests with the more slender beams and slabs and with the methods of support and of application of load which have generally been used in tests. With the present extensive application of reinforced concrete to footings, a more definite knowledge of the structural action of footings has come to be of importance. It is appreciated that the tests herein described are applicable only to a limited field, but they are offered as a contribution on a subject in which little experimentation has been done

The investigations were made in the Laboratory of Applied Mechanics of the University of Illinois as a part of the work of the University of Illinois Engineering Experiment Station.

The tests of 114 wall footings and 83 column footings are described in the Bullein.* The wall footings were 12 ins. wide, generally 5 ft. in length and 12 ins. in depth, or 10 ins. to the centre of the reinforcing bars, with a 12-in. by 12-in. by 12-in. stem in the middle to represent the wall through which the test load was applied.

The wall footing rested on a bed of springs arranged in such a way as to approximate conditions of uniform upward pressure on the bottom surface of the footing. A variety in method of reinforcement was employed to throw light on the development of tensile stress in the steel and on the resistance to bond, diagonal tension, and shear. Tests of brick footings, unreinforced concrete footings, and footings having I-beams encased in concrete were included in the investigation of wall footings.

The column footings were 5 ft. square, and generally 12 ins. thick or 10 ins. to the centre of the reinforcing bars, and had a 12 by 12 by 12-in. pier built over the middle through which the load was applied. The column footings also were tested on a bed of springs which gave conditions approximating those of uniform upward pressure. Variety was given to the amount and method of reinforcement and to other conditions with a view of determining the structural action with respect to tension, bond, diagonal tension, and shear, and to give information which would bear upon methods of calculation of stresses. It is thought that these are the first experimental tests on column footings, and probably the first on wall footings on a bed of springs. Analyses are given of the stresses in wall footings and column footings and methods of calculation are discussed and compared with the results of the tests.

General Theory

In wall footings and pier footings the weight or load is applied vertically through the wall or base block or pier, and the upward bearing pressure of the soil (which may also be called the load, since its amount and distribution determine the stresses) supports this weight from below. The usual assumption on which the design of footings is based is that the soil pressure is uniform over the bed of the footing. Before uniformity of pressure on the footing will obtain, the footing must bend to the amount and form which would be caused by a uniformly distributed load. The assumption of uniform pressure is warranted if the earth layer is an elastic compressible soil of considerable thickness and of not too high a modulus of compressibility, as under these conditions the amount of bend of the projection of the footing is slight in comparison with the amount of compression of the earth. Also, in soft soils which flow laterally, as in a so-called "floating" foundation, the settlement and changes in the soil will produce conditions approximating uniform pressure. Where the bed is rock the pressure will be transmitted more nearly directly from the wall or pier to the rock, and as the projections of the footing have little opportunity for being bent upward this portion of the footing may be expected to take only a small part of the load.

Analysis of Wall Footings

Fig. 1 (a) shows a wall footing and a typical set of external forces acting upon the footing. In the discussion, the stem or pier above will be called the wall, and the remainder the footing proper. The projecting portion of the footing will be called the projection.

The bending moment at a section of the footing x distant from the end (calling w the uniform upward pressure per lineal foot of length of footing for a given width of section) is

$$M = \frac{1}{2} wx^2 \dots\dots\dots\dots (1)$$

For a section at the face of the wall, the bending moment will be

$$M = \frac{1}{8} w (l-a)^2 \dots\dots\dots (2)$$

where l is the extreme dimension of the footing and a is the thickness of wall. For a section through the middle of the wall, assuming the load to be distributed uniformly over the wall, the bending moment will be

$$M = \frac{1}{8} w (l^2-la) \dots\dots\dots (3)$$

The variation of the bending moment along the footing is shown in Fig. 1 (b).

Although the maximum bending moment is shown by the above analysis to be at the section which passes through the middle of the wall, the resisting moment of that section will be far greater than that of a section of the projection of the footing in those cases where the wall and footing are poured at the same time or where they are well bonded together. Even with a weak bond the horizontal shearing stress at the junction of wall and footing will, in footings of the ordinary proportions, be so small that the combined section may be expected to act together. Besides, the pressure from the wall, instead of being distributed as shown, will be concentrated to some extent on the footing near the faces of the wall, as at A, Fig. 1 (a), and this will act to reduce differences of moments. Altogether, it may be expected that the section at the face of the wall will be the critical section for bending moment and resisting moment and that equation (2) will express the value of the critical bending moment as closely as may be determined by ordinary analysis.

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* University of Illinois Bulletin, No. 67.

Fig. 1 (b) shows also the variation in the external vertical shear V over the length of the footing for uniform loading. The theory of beams gives a distribution of the intensity of the vertical shearing stresses throughout the vertical section which is represented in Fig. 1 (c) . Due to a concentration of pressure near the face of the footing, as at A, Fig. 1 (a), and to the transmission of pressure, diagonally therefrom in a manner which is analogous to arch action (as is also to be found in short simple beams), it may be expected that at vertical sections near the wall the vertical shearing stresses will be greater in the compression portion of the vertical section and less below the neutral axis than is given by beam analysis.

This modification of the distribution of the vertical shear stresses may be expected to reduce the amount of the diagonal tension stress developed near the wall, and the position of the critical section for diagonal tension failure may be expected to be away from the face of the wall. The load stres sbetween the surface of the horizontal reinforcement and the concrete will also be affected by variations from true beam action.

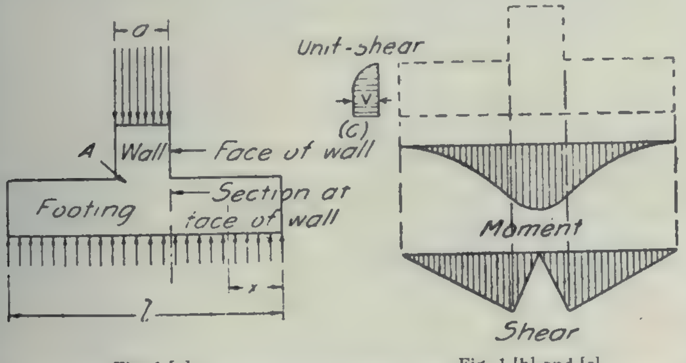

Fig. 1 [a] Fig. 1 [b] and [c]
[a] Distribution of load and pressure in wall footing; [b] moment curve and shear curve; [c] distribution of shearing stress over vertical section.

When footings are tested on a bed of springs, the deflection produced results in compressing the springs at the middle of the footing more than at the ends, and hence the pressure will not be uniformly distributed along the length of the footing. If the compression of the springs at points along the length of the footing is known, and also the deflection of the footing at these points, the distribution of the load may be determined and the resulting bending moment calculated. Fig. 2 illustrates the effect of the deflection of the footing upon the distribution of the load. The bending moment so calculated will be somewhat less than that based on uniform distribution of the load, and the amount of the resulting tensile stress, bond stress, and vertical shearing stress will be less. The amount of the difference will depend upon the stiffness of the springs and the deflection of the footing under load, but within so-called critical loads it will not be large. Of course, in designing footings, our knowledge of the distribution of the pressure by the soil is too imperfect to consider the effect of deflection upon distribution of pressure.

Analysis of Column Footings

In the column footing of the form used in the tests, the stem representing the bottom of a column or a pedestal block will be termed the pier, and its lateral faces the faces of the pier. The load will be considered as applied uniformly over the top of the pier, and the upward pressure as uniformly distributed over the lower surface of the footing. It is seen that the footing may be considered to be a cantilever slab (rather than cantilever beams) supported at the top over a central area and loaded uniformly by an upward load, and that as the projecting portion of the footing deflects upward its surface will be bowl-shaped, in reality a double-curved surface. The determination of the distribution of the stresses over the various parts of a column footing is a much more difficult problem than is presented in wall footings.

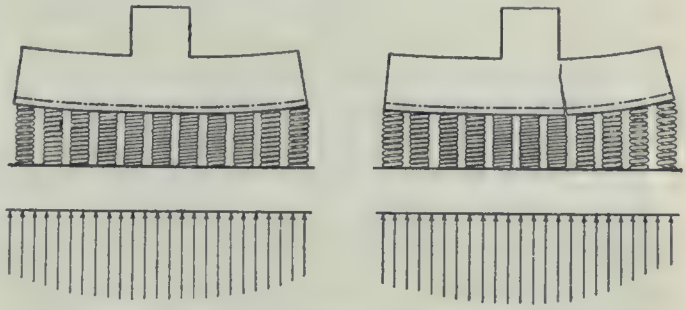

Fig. [2]
Effect of deflection of wall footing upon distribution of load by springs.

Various methods of calculating the strength of column footings have been proposed. In some cases the offsets have been considered as cantilever beams having the full width of the footing and the full load on this area is considered to be taken by this beam, the critical section being at AB, Fig. 3. Although the load at the corners is counted twice, the error is not great when the offset is small in comparison with the dimensions of the pier. If the dangerous section is considered to pass through the centre of the footing, EF, Fig. 3, a greater discrepancy exists. A common method of design is to consider that one-fourth of the total load is applied on the triangle EFG, Fig. 4, and having found the centre of pressure (as H) of the part of the load at one side of AB or CD (according to which is used as the dangerous section), to calculate the bending moment as the product of this amount of load by the distance from this centre of pressure to AB or CD, the dangerous or critical section.

When the bending moment has been obtained by one of these methods, it is considered to be resisted by a beam IKLM, Fig. 4, of width somewhat greater than the width of the pier, say, the width plus once the depth of the footing, according to the views of the designer. That is to say, the reinforcement in this assumed width is considered to develop stresses which altogether are sufficient in a beam of the depth of the footing to withstand the calculated bending moment. If the cross-section of the steel lying within the assured width is A, the resisting moment will be M = Afjd, where A is the area of cross-section of longitudinal reinforcement; f is the tensile stress per unit of area in the reinforcement; j is the ratio of the distance from the centre of the longitudinal reinforcement to the centre of gravity of compressive stresses to the distance d from the compression face to the centre of the longitudinal reinforcement. The steel lying outside the dotted lines is considered to carry load to the beam formed by the reinforcement which lies at right angles to these lines, just as the steel parallel to and near FG carries load to the beam IKLM, and in this method of design no account is taken of it in the main beam. Whether the spacing of the outer bars should be the same as that of the interior or be greater is then left as a matter of judgment. In the determination of both bending moment and resisting moment, then, the practice of engineers varies considerably.

A rational analysis of the stresses would involve a determinate expression for the deflection of the footing at every point of the cantilever slab and also for the radius of curvature in each direction. A full treatment would include a consideration of the effect produced by having stresses act at right angles to each other, and of the action of other combined stresses.

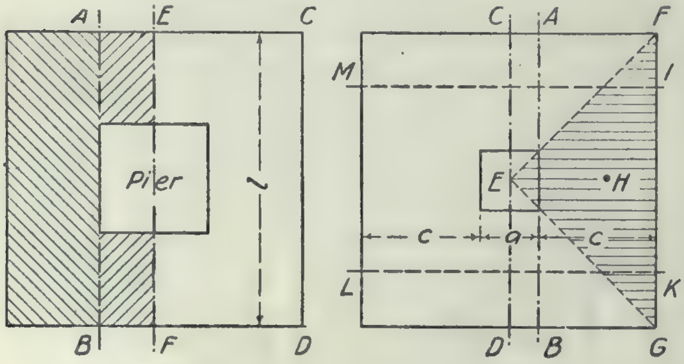

Fig. 3 Fig. 4
Loaded areas assumed in designing column footings.

It is easily seen that an analytical treatment of a cantilever slab of this kind which approached completeness would be very complicated. This and the uncertainty involved in the assumptions made at some steps of the analysis render the correntions of the results of the mathematical work of such an analysis quite problematical. In view of the complexity of the problem and the uncertainty of portions of the work, it seems futile to attempt to derive thoroughly rational formulae for stresses in column footings.

Details of an interesting and difficult engineering work were lately given by Mr. E. S. Sinnott, M. Inst. C. E., County Surveyor of Gloucestershire, Eng. The operation consisted in the protection of the foundations of Chepstow Bridge over the river Wye, by means of Mouchel-Hennebique ferro-concrete piles, after the removal of the old timber work. The task was rendered difficult and tedious by the great rise and fall of the tide, and by the fact that under the most favorable conditions two hours per tide was the available limit of working time. Each day the contractors' plant had to be cleansed from the sticky mud deposited by the previous tide, the pile frame being entirely submerged every twelve hours. Although the operations were carried on continuously day and night for over a year and a half, no fatal accident occurred, but the pile engine was once displaced by the force of the water.

Dangers in Bank-Run Material

To obtain good concrete, accurate proportions are necessary. If correct proportions are not specified, or if the specified proportions are not observed, high quality cannot be obtained. When a 1:2:4 mixture is specified, there is no excuse for allowing a 1:6 mixture of cement and "bank-run" aggregate. Such a statement seems entirely unnecessary, says "Engineering Record," and yet the rule is being daily disobeyed.

If the gravel pit is close at hand, a peculiar mental inertia seems to overcome the contractor, in consequence of which the cement is mixed with the bank-run material, without separating the sand and gravel and remixing in the correct proportions. This is bad practice, since in practically every bank the sand is generally twice the volume of the coarse material. But, to make matters worse, if a 1:2:4 mixture has been specified, the contractor thinks he will meet the specifications by using 1 part of cement and 6 parts of bank-run. Thus, instead of approximately one-quarter of a cubic foot of cement per cubic foot of concrete, only 1/6 of a cubic foot is obtained.

The idea then occurs that rather than take the trouble to separate the fine and the coarse materials, good concrete can be obtained by using 1 part of cement and 4 parts of the bank-run, but in most gravel banks the sand is about double the quantity of the coarse gravel, instead of the reverse which is to be desired. Thus, not only is less cement used per cubic foot of concrete, but the strength is decreased by the excess of sand. A report of analyses on samples of cement and bank-run, mixed in the proportion of 1 part of cement to 4 parts of the mixed sand and gravel, indicates that the mixture runs about 1:2¾:1¾, giving a weaker mortar and a smaller yield than the 1:2:4 combination.

Accurate proportions can be brought about only by the use of separate materials of known size and gradation. The contractor will be repaid for the expense of screening by the greater yield per barrel of cement; and the owner will secure a better, more uniform concrete.

Uniformity is impossible when bank-run gravel is used. There are many engineers who will question this statement, on the ground that it is always their practice to screen out a small sample, from which the amount of coarse material to be added is determined. The folly of this method of proportioning can be proved by screening samples from various parts of the same pit, which will show variations all the way from plastering sand alone to coarse gravel with no fine content whatever. No two wagon loads coming from the same pit will have the same proportions of sand to gravel—a strong argument for separation and remixing.

Good concrete, then, requires accurate proportioning of aggregate as well as accurate measurement of cement. To secure it, two points should be strongly impressed on all who write specifications or are entrusted with their enforcement: First, that the proportions must be correctly stated and adhered to; second, that accurate measuring of the separated aggregates must be insisted upon.

Methods of Sampling Sewage and Other Liquids*

By G. Bertram Kershaw

A very usual object for which samples of sewage and various other liquids are taken is to ascertain the chemical or bacterial quality of the liquid sampled, and thereby to determine the degree of efficiency with which a particular plant is performing its functions; as, for example, the purification effected on a particular sewage by tank treatment and percolating filters. Again, samples may be taken simply with a view to finding out whether the quality of the liquid produced complies with a particular standard.

In the former case, in order to be in a position to judge of the efficiency of the plant, it is necessary to know the strength and character of the sewage as well as the quality of the effluent. In the latter case this is unnecessary, the sample either passing or failing to pass a given standard.

It is of the highest importance that the sample analysed shall be duly representative of the bulk of liquid from which it is taken, otherwise erroneous deductions may be drawn. Inasmuch as quantitative analyses are necessarily somewhat costly, and gauging arrangements often involve a good deal of trouble and expense, it is very advisable, on these grounds alone, that the sample or samples drawn shall be as nearly representative as possible.

Nearly all waste liquids, especially those resulting from industrial processes, vary, not only in character but also in volume, from minute to minute, from hour to hour, and from day to day. Sewages, moreover, may also vary seasonally by reason of the influx of subsoil water and other factors; they vary markedly when heavy rainfall occurs.

If it is desired to ascertain the quality of a particular liquid at any given time, a single sample (termed a "chance" sample) will often suffice for the special or casual purpose for which it is taken. If, on the other hand, the character and strength of the liquid as a whole is what is to be determined average samples will be essential—that is to say, samples drawn according to the rate of flow of the liquid over at least four days.

Sewage Liquors

It will be obvious in the case of sewage liquors, which in dry weather vary in strength roughly according to the rate of flow, that if the hourly proportional flows for five consecutive hours are 10,000, 30,000, 50,000, 60,000 and 20,000 gallons, then samples merely drawn in equal quantities every hour will not represent the average strength of the liquid for the five-hour period unless the sewage is hourly of constant strength; whereas, if the samples are drawn hourly according to the rate of flow in quantities or, say, 100 c.c., 300 c.c., 500 c.c., 600 c.c., and 200 c.c., and mixed together, an average sample closely approximating to the truth will result. It follows, therefore, that in sampling for average strength the hourly rate of flow of the sewage must be ascertained; in other words, the flow must be gauged continuously while sampling is in progress.

Average samples of sewage liquors were taken as long ago as 1872 by the committee of the British Association at the Romford sewage farm, and probably long before that date, for liquors other than sewage. Average samples of sewage liquors have also systematically been taken by the Sewage Disposal Commission appointed in 1898, and it may be of interest to describe the method of taking average samples of sewage from start to finish, since sewages and sewage liquors are more likely to prove of general interest than the sampling of waste liquors from manufacturing processes.

The first preliminary to be settled is the duration of the period over which the samples are to be taken. In the majority of cases, four sets of twenty-four hours average samples, commencing Monday morning and ending Friday morning, will give a good idea of the character and strength of the sewage. In the case, however, of a large town, sets of average samples extending over seven days, repeated at different seasons of the year, may be necessary. In the case of domestic sewages from small communities, the first four or five days of the week usually constitute a sufficient period to provide data upon which, say, works could be designed; the omission of sampling the Saturday and Sunday sewage, which is often weaker than normal on these particular days, provides a certain factor of safety.

It is always desirable to draw average samples of sewage in dry weather, and hence it is necessary to determine what shall be regarded as dry-weather sewage flow.

The extent to which rainfall will affect the sewage flow will depend very largely upon local conditions, such as the nature of the sewerage system, the character and gradients of the surfaces of the drainage area contributing to the sewers, together with many other factors; but it depends, other things being equal, chiefly upon the intensity of the rainfall. For example, a rainfall of .05 in., or even more, following dry weather, and spread evenly over several hours, may produce little or no appreciable effect upon the flow of sewage, certainly not sufficient to put a stop to the taking of samples; but the question of continuing or abandoning drawing of samples must be left to the discretion of the sampler, who will generally be able to gain some idea from the sewage works manager as to whether or not the sewage flow is being materially affected by rainfall.

If two or three days precede the sampling operations, so much the better; but it is impossible to predict seven to ten consecutive days of dry weather in this country.

Since an automatic height recorder in connection with the gauging operations is advisable whenever it can be obtained, it is a good plan to fix a weir and run the recorder for seven to ten days before actually commencing sampling, thus obtaining a series of charts showing the general run of the sewage flow;

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* Paper read at the recent Annual Congress of the Royal Sanitary Institute of Great Britain.

comparison with these charts when rainfall occurs will generally show when it is inadvisable to continue sampling for the time being.

With regard to rainfall records at most sewage works of any size, a rain gauge is kept on the works, but if there is not one in use, a 5-in. gauge is easily erected, and records should be taken at 9 a.m. daily during the sampling. If a rain gauge is to be found in the town itself, daily records should be obtained from this source also, as it by no means follows that the rainfall in the town and on the works will be identical.

Apparatus

Now, as regards the apparatus required for taking twenty-four hours average samples of crude sewage, about thirty, or, better still, thirty-six wide-mouthed glass-stoppered bottles will be needed for chemical analysis; the use of the extra bottles (apart from chance of breakage) will be apparent later.

If samples for bacterial analysis are needed, a few small glass-stoppered sterilized bottles will also be wanted; these will generally be sent ready sterilized direct from the laboratory, and one or two of such bottles can be filled from the large mixing bottle when the twenty-four hours' average sample is made up. The stoppers of all the bottles, both chemical and bacterial, should be carefully ground in with fine emery, and the foot of each stopper rounded to avoid shutting in air bubbles.

As regards capacity, the larger bottles should hold about 600-700 c.c. each, and the sterilized bottles about 50 c.c. each. A large glass mixing bottle, holding about 1½ gallons, will be wanted for making up the average sample from the twenty-four separate hourly samples, and also a couple of thick glass stirring rods, and a measuring glass graduated in cubic centimeters; two thermometers, grease chalks, two or three drying cloths, and some adhesive labels complete the outfit. The bottles used for holding the mixed twenty-four hours' average sample are generally half-winchesters, holding about 1,300-1,400 c.c. each; but for special purposes a winchester is sometimes required.

Turning to the gauging outfit required: The method of gauging employed will depend upon local conditions. Whenever practicable, a wooden dam, with a brass or gunmetal rectangular weir plate screwed to the face of it is the simplest method, the whole of the flow to be gauged passing over the weir, and the depth of liquid over the weir sill being registered continuously by an automatic height recorder. "Plastic," or a mixture of clay and boiled linseed oil, is useful for making watertight joints between the margins of the wooden dam and the channel walls.

It may be well to point out here that to avoid complications in the formula for discharge, owing to the existence of material velocity of approach, one or two points need to be kept in mind.

(1) The width of the weir should not exceed about one-third the width of the channel in which it is placed.

(2) The transverse sectional area of the liquid falling over the weir should not exceed about one-fifth of the transverse sectional area of the liquid in the channel immediately above the weir.

(3) The weir and dam board should be perfectly upright, and have a free overall and air space underneath the falling sheet of water, while the float of the automatic recorder should be placed sufficiently far back from the weir to avoid curvature of surface.

As to the type of recorder, I have always used a small portable Glenfield and Kennedy machine, the drum being driven by a seven-day clock, and the pen actuated by the up and down movement of the float. There are, however, several automatic height recorders on the market, some of them with pen or pencil cams cut to give the discharge direct upon the chart. It is not, however, a difficult matter for any engineer to construct a simple and reliable machine for comparatively little outlay. Care is required in adjusting the pen to zero on the chart, which should be carefully pressed down to the rim at the foot of the drum.

Most recorder pens have an up and down range of 6 in., so that the depth over the weir must be limited to about 6 inches, unless the minimum early morning flow exceeds, say, 1½ inch depth over the weir, in which case the recorder can be made to register up to 7½ inches by setting the pen at zero on the chart when exactly 1½ in. of liquid is passing over the weir, the chart base line thus reading 1½ in. above sill level. The recorder should be set up perfectly level, and the float, if in an exposed situation, should be surrounded by a cylinder of fine perforated zinc, to eliminate wind action, otherwise oscillation of the float will soon exhaust the ink in the pen, besides blurring the chart. It may be mentioned that a mixture of glycerine and charcoal, or any aniline dye, makes a good ink for a recorder pen.

Having erected the weir and recorder, the sample bottles should be prepared and the time for commencing settled. Assuming 9 a.m. to be the hour determined upon, and that average samples of crude sewage are to be taken, the recorder should be started at 9 a.m., the second at 10.30 a..m, and so on hourly until 8.30 a.m. the following morning, when the first set of twenty-four hourly samples will be complete. The filling of each bottle is usually most conveniently done at the weir outfall.

It will be found convenient to write on each bottle the nature of the liquid, the date, and the hour of drawing; this can be done with grease chalks upon the glass direct, or adhesive labels can be used.

As each hourly bottle is filled the stopper should be allowed to sink down gently into place in the bottle neck; if this is not carefully attended to there is considerable risk of casualties when an attempt is made forcibly to unstopper the bottle. After stoppering the bottles should be set in a row in the order of the times at which they were filled. It will be found, when the twenty-four bottles are ranged in a row, that a wonderfully good idea can be obtained visually of the variations in the character of the sewage throughout the twenty-four hours.

Procedure

A point now arises as to the inclusion of fragments of faeces in a sample. Although they are usually omitted when taking chance samples direct with half-winchester bottles, this would appear to be a faulty method of sampling in certain cases, especially where the crude sewage subsequently undergoes treatment in septic tanks. If they are included they will need to be broken up in the hourly sample bottles before the proportionate amounts are drawn off.

After the last of the twenty-four hour samples has been taken, and the recorder pen has reached the 9 a.m. ordinate on the chart, the chart can be removed and replaced by a fresh one, and the hourly rates of flow worked out and entered up on the finished chart. The date, rainfall (if any), and other notes of interest should be recorded, such as times of weakest and times of strongest sewage, flushes of trade wastes, etc. For working out the hourly flows on recorder charts I use a special slide rule, which has the advantage of shortening the labor considerably. In the case of a recorder provided with a cam, the discharge can, of course, be taken direct from the chart; but with a recorder that only registers the height, height diagrams have to be translated into discharge diagrams.

The next step is to take from each bottle, commencing with the 9.30 sample, an amount proportionate to the rate of flow for each hour, and to transfer it to the large mixing bottle. Assuming the flow for the first three hours to have been severally 5,000, 6,500, and 8,500 gallons per hour, then if 50 c.c., 65 c.c., and 85 c.c. are taken from the first, second, and third bottles respectively, these amounts will be proportionate to the rates of flow for those hours, and the same procedure must be followed with the twenty-one remaining hourly samples.

The measurement of the liquid from the hourly sample bottle is best effected by means of a tall glass cylinder graduate in cubic centimetres. Before the sample bottle is unstoppered it should be turned over once or twice to mix the contents, and large solids should, if present, be broken up with a glass rod. In many cases the hourly amounts to be taken from each bottle can be obtained by knocking off two or more figures from the right of the hourly rates of flow, and if the figures thus obtained are inconvenient, the whole of these can be either divided or multiplied by a common factor. Care should be taken that the aggregate of the figures adopted are sufficient to yield enough liquid for the final sample; and it is better, if this can be done, to take sufficient liquid to fill two half-winchesters in case of breakage of one of them.

The working out of the chart and the sub-sampling, together with the entering up in the proper hour spaces of the chart of the times of strongest and weakest sewage, presence of trade wastes, etc., take some considerable time; and while this record is in progress the reserve bottles previously mentioned will be needed to take the first few hours of the second set of samples.

When the proportionate contents of the twenty-fourth hourly sample bottle has been transferred to the mixing bottle, the whole of the contents of this large mixing bottle should be gently agitated while the half-winchester bottle or bottles are being filled from it, in order to keep the suspended solids evenly distributed throughout the liquid. After the half-winchesters are thus filled the hourly sample bottles can be emptied, washed out with clean water, and set to drain. In cold weather, half-winchesters, or winchesters filled with sewage, tank liquor, or effluent, should be filled brimful, and the stoppers gently worked in, and tied down with a piece of calico or string; in hot weather, and also in keen frosty weather, a small air space may be left at the top of the bottle in the case of sewages or tank liquors. The samples should be despatched to the laboratory carefully packed in wicker cases or hampers, nothing being better than old crumpled newspaper for packing the bottles in. It is often useful to have a special sample of the weakest early morning sewage, taken in a half-winchester, to be examined for nitrates. These, if present, indicate the presence of subsoil water in the sewage.

It may be noted that in the case of very small sewage works, where an automatic height recorder cannot be obtained, depths over the weir can be taken with a thin steel rule, one edge of which is ground thin. Depths should be taken sufficiently far from the weir sill to avoid curvature, and it will be found that if the rule is rubbed lightly against a block of wet clay and allowed to dry before each reading, the exact depth can easily be seen at a glance. The gauging of sewage flows in this way is very tedious, since readings should be taken every ten minutes, or at even shorter intervals, should the flow of sewage fluctuate much, as will almost certainly be the case with a small sewage works. At least three observers are needed for the twenty-four hours for taking sill depths and drawing samples.

There is another method of taking average samples, in which samples are taken at regular intervals throughout the twenty-four hours, each of these samples being analysed separately; a "weighted sewage" can be obtained by multiplying each separate analysis by the rate of flow at the time the sample was taken, the results are then added up and divided by the total flow.

Some years ago the writer, having occasion to take a large number of average samples, designed an instrument for taking samples directly proportionate to the rate of flow in one operation. Briefly described, the instrument consisted of a paraboloid copper tube or container, about 12 inches long, ranging from about ⅝ in. at the bottom to about 2¼ in. at the top, the several diameters being calculated from the gauging formula. This tube was attached to a sliding metal stem working up and down in sockets screwed on to a rod provided with a thin sole plate, upon which the tube rested when the sample was taken. When in use the tube was raised clear of the sewage tank liquor or effluent, and the sole plate placed on the measuring stud, which was about ⅛ in.—i.e., the thickness of the sole plate—below the level of the weir sill. The tube was then dropped through the liquid on to the sole plate, and the intercepted liquid poured off direct into the mixing bottle; a thin rubber pad lying in a recess in the foot or sole plate prevented any escape of liquid, while a strong clip at the head of the instrument kept the container tube well home against the rubber. In this way, at each sampling, a portion of liquid was withdrawn proportionate to the flow of liquid; in other words, proportionate to the height of liquid flowing over the sill. Like most automatic contrivances, however, while possessing many marked advantages with certain liquids, containing suspended matter of moderate size, it had also several drawbacks, and the longer and more tedious method already detailed is to be preferred in most cases.

There are home-made automatic samplers to be seen in use at several sewage works, most of them actuated by a small water-wheel driven by a flow of sewage, tank liquor, or effluent.

Tank Liquors and Effluents

The sampling of tank liquors and effluents is effected in a similar manner to that already described for sewages, and it is easier, because less complicated by solids; and when both sewage, tank liquor, and effluent are sampled at the same time, it is often convenient to draw what are know as "corresponding samples." By corresponding samples is meant the taking of two or more samples of the same liquid in its different stages, a certain interval of time or "lag" elapsing between the drawing of each of the said samples. For example: assuming a sewage to be flowing at a uniform rate into a tank having a six-hours capacity, and that a sample of the sewage is drawn as it enters the tank, a sample of the tank liquor taken six hours later will be a sample—other things being equal—corresponding to the sample of sewage.

It is often necessary to use dyes, such as fluoresin or eosin, in order to follow the progress of a particular liquid through several processes . For example, if the temperature of a liquid entering a settling tank is much higher than that of the liquid in the body of the tank, short cuts through the tank at the surface are almost certain to occur, and a dye, such as fluoresin, shows this at once. Samples should be taken just before the dye reaches the sampling point to avoid including the dye in the sample.

Corresponding samples are also exceeding useful in showing the relative amount of work brought about by the several stages of a purification plant; the only objection to them is the time occupied in obtaining a complete set. It may be noted that the chlorine figures on analysis will usually but not invariably, show whether the samples of sewage liquor correspond properly.

Effluent From Contact Beds

With regard to the taking of samples of effluent from contact beds, it is well known that the quality of a contact bed effluent varies considerably as the bed is being run off, being worst when the outlet valves are first opened, afterwards gradually improving until the bed is practically empty. It has also been found to be the case that samples taken at the period of midflow from the bed, approximate closely to the average quality of the whole of the effluent discharge, and it is therefore sufficient, in the majority of cases, to take a sample at mid-flow from each particular bed discharge, and to mix the whole of them together to make up the twenty-four hours' average sample.

Storm-water samples can be taken automatically, if desired, by fixing a vessel on the side of the storm overflow manhole at the level at which the required dilution occurs.

Care should be taken in sampling all sewage liquors that no sediment is stirred up in any channel or manhole and mixed with the sample, otherwise the sample becomes worthless. This is of especial importance in taking samples of effluent.

It is, perhaps, not generally realized how much effluents vary in composition in the course of the twenty-four hours, even in the case of land effluents, and when it has been customary to take a sample of effluent regularly at the same hour daily, it is often surprising to see the difference shown by average samples taken over the whole twenty-four hours.

Trade Wastes

The sampling of trade wastes stands on a different footing to the sanding of sewage liquors. A thorough working knowledge of the particular trade in question is needed if the sampler is to take representative samples. Trade wastes vary in character in short intervals of time, owing to the different operations which are frequently in progress at the same time at the one manufactory, as, for example, where bleaching, printing and dyeing are carried on simultaneously at the same works, as is often the case.

In the case of many trade wastes, when taking average samples it is advisable to take a sample every five or ten minutes owing to their rapidly varying character, and each separate sample should be tested with litmus for acidity or alkalinity, and the temperature noted. It is frequently desirable to take samples of each of the various liquors from a manufactory as well as of the general or mixed waste; in such circumstances, difficulties in arranging the flow are apt to arise, the contents of vats being let off with a rush in the space of a few minutes, the chart of the recorder consequently showing an abrupt vertical line which cannot be integrated for discharge. In such cases a number of dip samples may be taken, and the capacity of the vat or tank taken, and noted in pencil on the chart at the proper point.

At some manufactories with which the writer is acquainted, a variety of gauging expedients have been necessary in order to arrive at accurate information as to the volume of discharges.

Most trade-waste investigations demand a rather elaborate scheme to be laid down before satisfactory sampling can go forward, and since the analysis of many of these wastes is laborious and intricate, and consequently costly, it is very advisable that, as in the case of sewage liquors, the samples shall be as far as possible representative of the liquids from which they are drawn. Many trade wastes, it may be mentioned, do not, owing to their nature and colour, admit of the use of eosin or fluoresin for tracing the various liquids through their several processes.

River Samples

River samples require considerable care in taking, especially where large rivers are concerned, and where bacterial samples are in question; the boat from which the sampling is done often itself carries contamination on its sides at the water line. All river samples should, wherever practicable ,be cross-sectioned ones—i.e., a number of samples should be taken on a line normal to the axis of the river—and these should be mixed together for the final samples.

For the taking of surface samples in large rivers, I have found two glass tubes of ⅜ in. internal diameter wired together, and about 18 ins. long, exceedingly useful. As a boat is rowed very slowly along the section line, dip samples are rapidly taken every 6 ft. or so. alternately 6 in. and 2 in. deep, and the fingers or palm of the hand closed over the top apertures of the tubes, which are then quickly emptied into a glazed earthenware pail. If corresponding samples are needed, the river water should be coloured with fluoresin when the first set of samples are taken, and practically the same body of water can then be detected and resampled lower down. Two or more samplers are needed for taking the second sample as quickly as possible just before the dye reaches the cross-section. To those who have been accustomed to judge the average velocity alone, the slow average rate of flow shown by the fluoresin will come as a revelation.

There are many other ways of taking special samples, such as deep-well samples, many of them requiring specially designed and expensive apparatus, but they are perhaps of special and not general interest, and for that reason they are not included in this paper. In conclusion, it may be observed that, although the procedure involved in obtaining true average samples may appear at first sight to be too refined for general use, it should be carefully borne in mind that a substantial error in the strength and character of a sewage—such as may very easily arise if a few casual samples taken at haphazard are relied upon—may be the cause of sewage purification works being constructed not competent to bring about a proper degree of purification of the sewage they are called upon to treat.

The Prevention of the Sub-Crust Movement in Roads

By E. S. Sinnott, M. Inst. C. E.*

FROM time to time the writer has had under his observation the behaviour of roads subjected to heavy traffic, and he has recently initiated certain experiments to determine, as far as possible, the lateral and longitudinal movement of material forming the sub-crust of highways.

As a preliminary to more precise investigations, he has arranged during the past few months for various sections of grass verge adjoining the principal roads in Gloucestershire to be opened, and some of the results of such openings are shown.

Speaking generally, these indicate that lateral movement, in some instances to a considerable extent, has been taking place, and such movement seems to call for special consideration.

The following examples will serve as illustrations:—(i.) On main road (Gloucester to Bristol) at Whitfield, near Falfield. At this point the grass verges were opened on both sides of the road, and on the west side there was found, at a depth of about 4 inches, a bed of broken limestone having a width of 3 ft. from the metalled surface, varying in thickness from 7 ins. nearest the road to 4 ins. at the three feet distance. On the east side a somewhat similar state of affairs was found to exist, the width in this case being 2 ft. 6 ins. from the verge. The subsoil is a hard red clay. (ii.) On main road (Bristol to Malmesbury) near Chipping Sodbury. In this instance the lateral thrust is shown in the movement of a line of channelling formed of three stones on edge put in to protect the foot of a bank; originally laid with a horizontal face of thirteen inches in width, the stones have been forced into a vertical position, having moved through an angle of 90 deg. In several instances the upper stones have been forced completely over, having rotated through an angle of 180 deg., and have fallen backwards into the highway, their movement away from the road being arrested by the bank they were put in to protect. The subsoil is clay.

(iii.) On the main road (Gloucester to Bath) between Hardwicke and Stonehouse. In this case metalling and pitching have been found from three feet to five feet from the metalled surface, and about eighteen inches in thickness. The subsoil consists of clay and sand.

(iv.) On the main road (Cirencester to Cheltenham) at Baunton Hill. The opening at this place showed that the original pitching and oolite macadam had been forced for a distance of four feet from the edge of the metalled surface, the outer end showing an upward movement. The subsoil is clay.

The results above described indicate generally the position of affairs upon roads where traffic is heavy, although in a small minority of cases investigated little or no movement could be detected. It appears evident, however, that where lateral spread does occur it cannot fail to be ultimately destructive, as without substantial and immovable support the top coating cannot be kept up to its work, particularly after some wear has taken place, and it becomes a question how far new surfaces of an expensive character are justified before the sub-crust movement referred to has been arrested.

With a view to obtaining more accurate information, the writer has lately placed a number of iron bolts below the surface of certain roads, and has fixed their position exactly by steel tape measurement, so that any movement can be definitely ascertained on a future occasion.

He has also inserted measuring instruments at various places, which consist of two rods arranged to slide one over the other, having plates at their outward extremities, which will enable any movement, either lateral or longitudinal, to be recorded.

As a means of preventing the action above described, the writer has recently designed and put into use a rigid framing, the essential feature of which is that longitudinal and cross members placed at a suitable depth below the surface preclude any movement of the sub-crust, and at the same time provide a means of constructing an impervious arch of tarred macadam to carry the traffic, great additional strength being provided by the longitudinal members for the support of the heaviest road vehicles.

For various reasons, the writer thought it best to construct the frames in ferro-concrete, although timber or other material could, if preferred, be used.

The form adopted after one or two experimental frames had been made was shown.

The longitudinals are 12 in. by 3½ in. (average thickness) by 12 ft. long, and are slightly tapered from top to bottom. The ends of the longitudinals are securely housed at the extremities of the cross ties.

The reinforcement consists of expanded metal 3 in. mesh ¼ in. by 3-10 in., weighing 11½ lbs. per superficial yard, cut into strips 9 ins. wide—in the case of the cross ties this is supplemented in a minor degree with wrought iron round bars of small section at the ends of the same.

A further modification consists of making the longitudinals slightly curved on the inside, in order to withstand lateral thrust more effectively; also, where difficulties due to traffic may be anticipated, in placing the cross ties in position they can be made in two parts and connected in the centre with a bolt or bolts.

In the experimental frames which have been put down, the width between the longitudinals has been fixed at 8 ft., but there is no particular reason for adopting this dimension, other than it appears suitable for dealing with the traffic conditions of rural roads in Gloucestershire, where most of the heavy weights are carried in the central portion of the highways.

If considered advisable, a greater width than 8 ft. may be adopted between longitudinals, or where traffic conditions justify it, the central pair can be supplemented by longitudinals on either side, connected thereto by cross ties similar to those previously described.

The frames have been placed, the top edges of the longitudinals being 6 ins. below the finished road surface, which, from the information at present at the writer's disposal, appears the most suitable position for arresting the lateral movement, also at this depth there would be little or no interference with pipes, and with 6 in. cover over the top side of the longitudinals there appears to be sufficient cushion to avoid any damage thereto.

Dr. Imhoff, of Essen, Germany, the designer of the well-known tank, has cancelled his proposed visit to Canada and the United States. It is fair to assume that the doctor is detained by affairs of pressing urgency.

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* County Surveyor, Gloucestershire, Eng.

Constructional Details of the Concrete House[*]

THE all-concrete residence can compete with frame or brick as to first cost, and furthermore it is practically fireproof; it is everlasting, and it is the only completely sanitary habitation yet devised for man; its steel reinforcement and monolithic construction make it best adapted to withstand earthquake strain and shock; its great weight in addition to its monolithic steel construction makes it proof against flood and tornado; it fulfils every requirement that could possibly be asked for in a home.

The construction of a concrete house is really nothing more complex than the putting together of the foundation, outside walls, floors, roof, partitions, stairways, columns, and chimneys.

Wall Construction

A 12-in. wall provides, in addition to the 2-in. on the outside for a water table, a ledge 2 in. wide on the inside to support the first floor.

A cellar wall, while it is really a foundation wall, acts as a retaining wall at the same time. It must withstand the weight of the building and also the earth thrust, the latter tending to collapse it. For a cellar 8 ft. deep or less, a 12-in. wall is sufficient. The bottom of it ought to be about 12 ins. below the cellar floor, to provide stability at its base. No reinforcement is needed unless the wall is longer than 30 ft.; then reinforcing should be provided, to avoid shrinkage cracks. If a waterproof wall is desired, it should be reinforced, regardless of size. Suitable reinforcement would be strong triangular mesh or other form of wire mesh, expanded metal fabric, or ¼-in. round rods spaced 1½ ft. apart vertically and 2 ft. apart horizontally. Stones should be set in the top of the wall, embedding half their depth in concrete, to form a bond between the foundation and building proper.

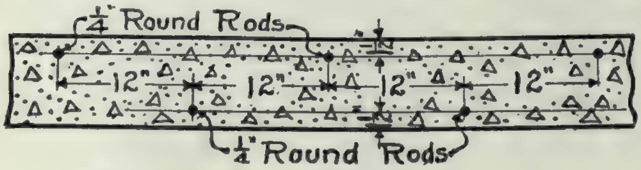

Fig. 1.—Arrangement of vertical reinforcement in walls.

The outside walls should be 8 ins. thick from the bottom up to the under side of the second floor slab or beams, and 6 ins. thick from that point to the top, a 2-in. offset being made on the inner face. The 2-in. ledge formed by the wall is used to support the second floor. It is necessary to reinforce the walls both vertically and horizontally. The vertical reinforcement should consist of ¼-in. round rods, placed alternately, 1½ ins. from each face and spaced 1 ft. apart (Fig. 1). For the horizontal reinforcement, ¼-in. round rods 2 ft. apart will be satisfactory. These should be placed outside of the vertical rods near the outside face of the wall, and securely tied to them with wire ties. Around all corners, additional ¼-in. round rods, extending 3 ft. beyond the corner, should be used, placed 4½ ins. apart and running crosswise of the corner in either wall. These should be set inside of the vertical rods, near the inside face of the wall, and tied to them with wire ties. It is advisable to place two ¼-in. rods around all openings in the wall. They should be of such length that each end of the rod should extend 1 ft. beyond the open space. It is also necessary to provide a satisfactory bond between the floors and the side walls. This is best done by setting L-shaped rods in the wall. One leg of these rods should be made 1 ft. long, and the other a length equal to ¼ the distance between floor supports. The short leg should be placed end down in the wall, 2 ins. from the inside face, and in such a position that the other leg will be embedded in the slab 1 in. below the top surface of the floor. Their size and spacing should be the same as the floor-slab reinforcement.

In order to insure against dampness, in the case of solid walls, it is best to fur the walls on the inside. This can be easily done by using 1½ by 3-in. furring strips, set 2 ft. apart, and wood or metal lath. The

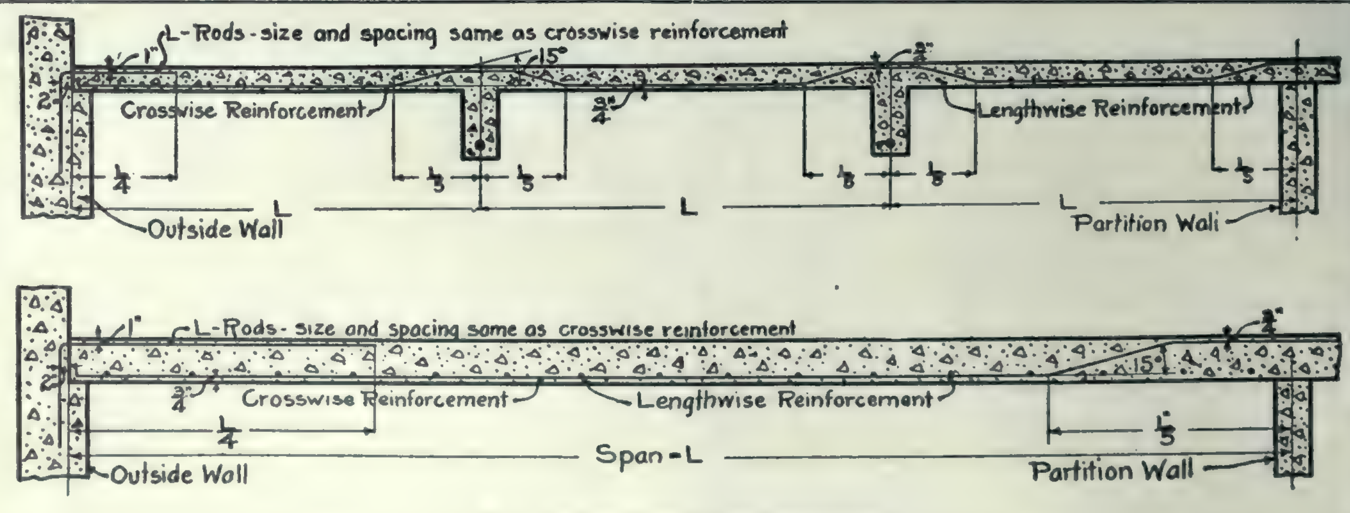

Fig. 2.—Sectional details of floor construction.

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[*] From data furnished the Cement World by J. F. Rhodes, Canada Cement Company.

walls are then plastered in the same manner as in ordinary construction.

In building the floors, either a flat slab or a combination of slabs and beams can be used. When a flat slab is used, its thickness and the amount of reinforcement required will depend upon the size of the room. These are given in Tables 1 and II.† Suppose the room is 12 by 16 ft. The width of slab will be 12 ft., and the length 16 ft. Then, in Table I, opposite 12 and under 16, the required slab thickness is found to be 5 ins. Turning to Table 11, in a similar way it is found that ⅜-in. round rods placed 4½ and 9½ ins. apart are necessary. The 4½-in. spaced rods should run crosswise of the slab, and those 9½-in. apart should run lengthwise.

For spans longer than 8 ft., the slab-and-beam type will generally be found the cheaper. This type produces a beam ceiling which will give a very pleasing effect when properly finished. The dimensions of the beams go a great way toward giving the desired result. Table III* gives the size of beam to use for different span lengths; and Table IV*, the required reinforcement for the beam. Using the same size room as in previous case, 12 by 16 ft., the floor will be designed for the beams running the narrow way and placed 4 ft. apart. Then, in Table III, for a beam 4 ft. c to c, and span of 12 ft., opposite 4 and under 12 it is found that a beam 4 ins. wide and 8 ins. deep is required. In the same way, the reinforcement is found to be one ⅞-in. round rod. The thickness of the slab necessary for the beams placed as above is now found in Table I. Opposite 4 and under 16 is 2½ in., the required thickness. In Table II the reinforcement is found to be ¼-in. round rods 7¼ ins. apart running crosswise of the slab, and 30 ins. apart lengthwise of the slab. For any other arrangement of the beams, the same method of procedure will apply.

TABLE I
Thickness of Floor-Slabs in Inches

Width of Slab in Feet	Length of Slab in Feet						
	4	6	8	10	12	14	16
4	2½	2½	2½	2½	2½	2½	2½
6		2½	2½	3	3	3	3
8			3	3½	3½	3½	3½
10				3½	4	4½	4½
12					4	4½	5
14						4½	5
16							5½

TABLE II
Spacing of Reinforcing, in Inches

Width of Slab in Feet	Length of Slab in Feet							Diameter of Rods
	4	6	8	10	12	14	16	
4	12 12	8 16	7¼ 30	7¼ 30	7¼ 30	7¼ 30	7¼ 30	¼"
6		6¼ 6¼	4¼ 7	4 30	4 30	4 30	4 30	
8			10 10	8 12½	6¾ 15	6 30	6 30	⅜"
10				7¼ 7¼	5½ 7½	5½ 9	4¼ 30	
12					5½ 5½	4¾ 6	4½ 9½	
14						4½ 4½	4 4½	
16							4 4	

NOTE—Upper figures are for short reinforcement; lower figures for long reinforcement.

The reinforcement should be installed as shown in Fig. 2. All joints in the reinforcement should come over the supports, and should be lapped 2 ft. The reinforcement should be accurately spaced and firmly held in place so that it is not moved when the concrete is deposited.

The floor finish may be concrete or wood. If a concrete finish is desired, it can be done either by working the slab smooth on top, at the time it is placed, or by leaving it rough and applying a finish coat later. If a finish coat is applied, the surface of the slab should be roughened by scrubbing with a solution composed of four parts of water to one of muriatic acid, the surface then being thoroughly cleaned with water, and the finish coat applied. The proportions of this coat should be 1 part cement to 2 parts of sand. It should be made 1-in. thick. If a wooden finish is desired, making strips 1½ by 2 in. should be placed on the concrete slab, with their edge bevelled so as to be firmly held by the concrete. They should be placed about 2 ft. apart, and the space between them filled with a cinder concrete composed of 1 part cement to 2 parts sand and 5 parts hard, clean cinders.

TABLE III
Size of Tee-Beams below Slab

Center to Center of Beams in Feet	Span of Beams in Feet						
	4	6	8	10	12	14	16
4	4 x 8	4 x 8	4 x 8	4 x 8	4 x 8	4 x 8	6 x 12
6		4 x 8	4 x 8	4 x 8	6 x 12	6 x 12	6 x 12
8			4 x 8	6 x 12	6 x 12	6 x 12	6 x 12
10				6 x 12	6 x 12	6 x 12	6 x 14
12					6 x 12	6 x 12	6 x 14
14						6 x 12	6 x 14
16							6 x 14

NOTE—First figures are width of beam; second, depth of beam below slab.

TABLE IV
Reinforcement of Tee-Beams

Center to Center of Beams in Feet	Span of Beams in Feet						
	4	6	8	10	12	14	16
4	1-½"Ø	1-½"Ø	1-⅝"Ø	1-¾"Ø	1-⅞"Ø	1-1"Ø	1-1"Ø
6		1-⅝"Ø	1-¾"Ø	1-⅞"Ø	2-⅝"Ø	2-¾"Ø	2-⅞"Ø
8			1-⅝"Ø	2-½"Ø	2-¾"Ø	2-⅞"Ø	2-1"Ø
10				2-½"Ø	2-¾"Ø	2-⅞"Ø	2-1"Ø
12					2-¾"Ø	2-⅞"Ø	2-1"Ø
14						2-⅞"Ø	2-1"Ø
16							2-1"Ø

NOTE: The sign Ø is used to designate round rod.

How to Build the Roof

The roof can be built of either the flat slab or a combination of slabs and beams. The slab thickness, size of beams, and reinforcement will be found the same way as for the floors in the tables already given. The top of the slab should be left rough so that the finish coat will have a good bond with it. It is also advisable to sprinkle stones up to ½ in. in size over the top of the slab when the concrete is placed, as these will aid in bonding the finish coat. This finish coat should be made 1-in. thick, of a mortar composed of 1 sack of cement to 2 cu. ft. of sand and 9 pounds of hydrated lime or the proper proportion of some other well-tested waterproofer. Before applying it, the slab should be well wetted with water and thoroughly cleaned. If the finish coat can be applied within an hour after the slab is placed, it is always advisable to do so. When this is done, the wetting of the slab surface may be omitted. The finish coat should be worked to a very smooth surface so that the water will run off freely. The roof can be made any desired color by adding the proper quantities of mineral pigment.

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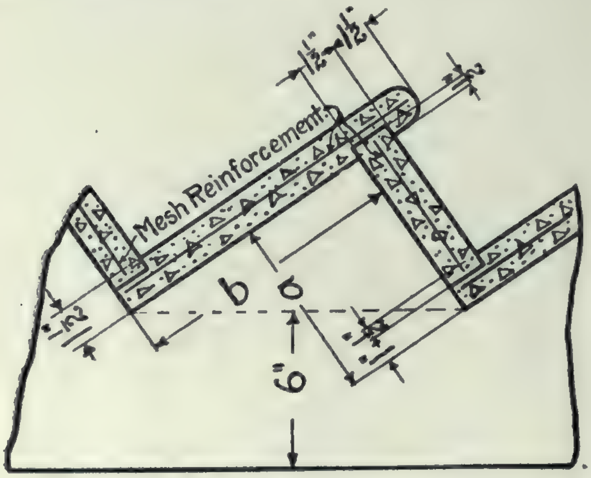
†Tables I. and II. are based on the following values: Load per sq. ft. = weight of concrete + 50 lbs. Stresses—Concrete 600 lbs.; steel 16,000 lbs. Bending moment = Wl/8.

*Tables III. and IV. are based on the same values as Tables I. and II. with the following addition: width of T-beam = 10 times the slab thickness.

Partitions and Stairways

The partitions should be not less than 4 ins. thick, and reinforced both horizontally and vertically, the same in every respect as for the outside walls.

The stairways are most easily and cheaply built by casting the stair stringers in place, the treads and risers separately, and then assembling them. For a stairway 3 ft. 6 ins. to 4 ft. wide and 9 ft. high, three stringers should be used, having a minimum depth of 6 ins., measured at right angles to the back of the stringer, and a width of 4 ins. Each stringer should be reinforced with a ½-in. round rod set 1-in. from the under side of the stringer. A rod of the same size should be left extending 1 ft. out of each floor (in a manner similar to that used for floor construction), to be embedded in each stringer when it is made, so as to get a solid connection.



The treads and risers should be made as separately molded members, as shown in Fig. 3. They should be made of a concrete composed of 1 sack of cement to 2 cu. ft. of sand and reinforced with a woven wire fabric or metal lath. The reinforcement should be set in the middle of the slab. After the treads and risers are at least two weeks old, the stairway is completed by grouting the parts in place with a cement grout composed of equal parts of cement and sand.

If columns or posts are used, they must be of such a size that their least dimension is 1-10 of their height. Thus, if a column is 10 ft. high, it should not be less than 1 ft. square. All columns should be reinforced with four 1-in. round rods, set 2 ins. in from each corner. These should be tied together with wire ties not more than 1½ ft. apart.

Chimney Construction

The chimney should be built upon a solid foundation in no way connected with that of the house. This foundation should be 2 ft. larger each way than the outside dimensions of the chimney, and 1 ft. thick. The size of the chimney will depend upon the number and size of the flues it contains, together with an allowable minimum wall thickness of 6 ins. At the bottom of the chimney, a clean-out hole should be left for each flue.

The cheapest and easiest way to build the chimney is to use tile, the size of the flue, for the inside forms which are left in place. These are used because wooden forms are very hard to build and to remove. The outside forms will consist of merely a wooden box, which can be moved as the work progresses. Care should be taken in building the chimney, that no connection is made between it and the house in any way.

If the ordinary hard wall plaster finish is desired on the inside of the building, this can easily be done by making the surface of the concrete rough where the plaster is to be applied. This is best done by using unsurfaced matched lumber for forms, and then scrubbing the concrete surface with a wire brush or stiff broom when the forms are removed. The surface should then be thoroughly wetted before plaster is applied.

The mixture of concrete to use in all parts of the building where not previously specified, should be composed of 1 sack of cement to 2 cu. ft. of sand and 4 cu. ft. of crushed stone or gravel.

Cuts in pavements in the city of Westminster, Eng., are reduced to a minimum by a method which is commented upon by George W. Tillson, consulting engineer of the Borough of Brooklyn, New York City, in his recent report on investigations of pavements in European cities. Wherever possible, Mr. Tillson says, subways, telephone and electric light lines are laid in the sidewalk area, so that the roadway will not be disturbed during construction or repairs. The most striking practice of reducing the number of street openings is the ruling that no sewer shall be smaller than 2 ft. 4 in. x 3 ft. 6 in. Workmen, therefore, can enter the sewer and tunnel from it into the house line for a connection, and in this way the surface of the street is not disturbed. This practice, Mr. Tillson points out, is particularly interesting from the fact that in America most cities will not permit tunnelling except under special conditions.

Plugging pavements to see whether specifications have been adhered to is a practice followed in Baltimore. Although there is a thoroughly competent system of inspection, both at asphalt plants and at streets, the desirability of a further check was felt recently when a great many contracts were being completed. Before final payments, therefore, it has been customary to cut out carefully a plug about 2 in. square through topping and binder, which is replaced after measurements have been made. If properly done, this is a very simple and rapid operation. No violations of specifications have thus far been disclosed.

The convention of the American Chemical Society, which was to have been held in Montreal this fall, has been cancelled owing to the war. The members were notified that the harbor and canals at Montreal were under martial law and that those with German names would be questioned very carefully at the boundary. Many of the most prominent members of the Society are of German birth or extraction. The membership is strongly represented in the municipal engineering field.

The Efficient Design of Small Waterworks Systems*

IN Massachusetts there are 215 water supply systems, and of these 152 were installed before the population of the towns they supply was 5,000, and 111 or more than half are now still supplying towns of less than 5,000. In fact, the opportunity seldom comes to design a complete system of works for a large community, the larger systems being extensions of the system designed for the small town. As there are only four towns in Massachusetts having a population of more than 3,000, which remain unsupplied with water, it is likely that, in that State at least, the problems arising in small systems will be more numerous than the problems connected with the larger systems although perhaps not so interesting to any but those immediately affected.

It has been my lot to put in a number of small waterworks plants, and it has surprised me to see how easily 10 per cent. of the cost of construction may be saved by a thorough study of the problem. I have also found that many problems over which I have worked have been solved by others who have kept the results to themselves, not because of unwillingness to part with the information, but because the matter seemed too small to be of general interest. It is with a view of encouraging the discussion of the problems connected with small waterworks installations, as well as to give a few of the results of my own experience, that this paper is presented.

Provision for Future Requirements.—The works should be designed for a long time in the future, but the design should provide for as little immediate construction as is possible except where the cost of extensions or increased capacity will be much more than the cost of doing the work in the beginning.

To build works for a long time in the future assumes a power of prophecy which most of us do not possess. It is impossible to foretell the future growth of the whole or any part of the community. The advancements in the art of water supply engineering are so rapid that portions of the plant are likely to become obsolete before they are worn out. The requirements of the public which uses the water are changing very rapidly. For these reasons it is desirable to build only for the immediate future, and to plan for additional works to be constructed as they become necessary.

Fire Protection Requirements.—The capacity of the distributing system is determined, in the case of the small town, by the fire-protection requirements solely. One good effective fire stream will use water at as great a rate as the ordinary town of 5,000 inhabitants will require for domestic purposes during the hours of maximum draft.

The quantity of water which will be drawn from the sources of supply depends upon the population to be supplied, the character of the residences supplied, the care taken to prevent leaks and other wastes and the use of water for manufacturing or mechanical purposes. It is exceedingly difficult to evaluate these factors since it is impossible accurately to forecast the industrial development or retrogression of the average small community. The population to be served depends primarily upon the growth of the community's industries. A future per capita domestic consumption of from 75 to 100 gals. per day for ordinary small towns does not seem unlikely and in the case of towns having large estates and a large area of well-kept lawns the consumption may be much larger.

Metcalf, Kuichling and Hawley, in a recent paper before the American Water Works Association, state that "the cost of the portion of the waterworks plan involved by fire protection probably constitutes from 60 to 80 per cent. of the entire cost of the physical property in the case of communities having less than 5,000 population." This is undoubtedly true except in those places where it is necessary, in order to secure water of sufficient purity for domestic purposes, to go to a large expense in obtaining it or in its purification.

In a small town it is usually necessary to depend entirely on hydrant streams without the use of steamers and it is essential, therefore, that the works, either by themselves or assisted by some outside source, should furnish both the requisite quantity of water and the proper pressure with which to fight the greatest conflagration which is likely to occur, and to do this under the most unfavorable conditions in regard to domestic consumption and quantity of water in reservoir or stand-pipe.

Fire Streams.—The standard fire stream is now considered to be that thrown by a 1⅛-in. smooth nozzle, discharging 250 gals. per minute, and it is generally considered by the insurance engineer that a hose stream which does not throw 200 gals. per minute is not a good stream. There are many cases, however, where smaller streams throwing from 150 to 175 gals. per minute would furnish reasonable protection and this is all that a town would be justified in providing in some districts. In the outlying sections of small towns, any fire which gets sufficient headway in the ordinary building so that it cannot be controlled with two streams of 150 to 175 gals. each is not likely to leave much of value if it is extinguished by using six streams. In such cases, the value of the water is chiefly in saving adjacent buildings and for this purpose even small streams are of great value. For streets in a district where the houses are small and occupy comparatively large lots with no prospect of any considerable increase in density of population, and where extensions of the mains are not likely, a hydrant which will furnish 300 gals. per minute under a suitable head to any building in the territory supposed to be covered by this hydrant, will be good fire protection. More is desirable but the advantages are not sufficiently great to warrant the expense of larger mains to secure it. In a district where the houses are nearer together but where there are no business blocks, apartment houses or other large buildings, it should be possible to get 500 or 600 gals per minute at any point. Where there are business blocks and other large buildings and where the buildings are very close together, as they frequently are in the center of a small village, it should be possible to get 1,000 gals. per minute. Where there are factories or other special fire risks, a much larger quantity may be necessary and a special study should be made of each case.

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* Abstracted by Engineering and Contracting from a paper by W. S. Johnson before the New England Waterworks Association.

Pressure and Hydrant Spacing.—The pressure required at the hydrants while the hydrants are being used should be great enough to force the water through the greatest length of hose which will be used and throw it to a sufficient height to cover any building. The hydrant spacing and the pressure should, therefore, bear some relation to each other. Table I, from E. V. French, gives the limit of a good efficient fire stream with different lengths of good rubber-lined cotton hose, with a constant pressure of 60 lbs. at the hydrant, with moderate wind. Table I also gives the corresponding amount of water which would be discharged.

Table I.—Height and Volume of One 1⅛-in. Stream Flowing From a Smooth-Bore Nozzle

100	67	250
200	59	222
300	52	206
400	44	188
500	40	178
700	33	158
1,000	25	140

Table I shows the importance of having hydrants near the buildings to be protected. Unless the hydrants are near enough to furnish water at the fire under a good pressure, the expense of large pipes and a high reservoir is largely wasted. The cost of a two-way hydrant in place is about $40 and in the ordinary distribution system about eight hydrants are required per mile of street main to keep the hydrants within 250 ft. of every building in the territory covered; so that the expense of hydrants is very small compared with the expense incurred in other parts of the system to obtain efficient fire protection. In general, hydrants should not be more than 500 feet apart in the outlying sections. In the more closely built-up sections they should be so spaced as to make it possible to get the number of streams which are considered necessary at any particular point with the use of not more than about 300 feet of hose for each stream. This figure may be modified, however, if the pressure is unusually low.

The minimum pressure desirable for good fire protection with hydrants spaced as suggested, is about 50 lbs. per square inch at the hydrants when they are in use. This pressure will give, with 300 feet of best quality hose and a 1¼-in. nozzle, a stream of 185 gals. per minute, which can be thrown to a height of 44 feet. With 200 feet of hose, the quantity thrown would be about 200 gals. per minute and the height would be increased to 50 feet. There are cases where in the higher sections of the town these pressures are almost impossible and in such places the hydrants should be so located as to require as little hose as possible. In the case of thickly built up villages, the pressure should be 60 lbs. per square inch at the hydrant when the water is being drawn at the maximum rate. This pressure will give a stream of more than 200 gals. per minute with 300 feet of hose and with 200 feet of hose will throw 222 gals. per minute to a height of about 60 feet.

Size of Mains.—The size of the mains depends entirely on the requirements determined on to give fire fighting facilities and on the head available. When these are known, the system can readily be designed. Generally, however, the head which can be secured is not fixed but can be made whatever is desired by going to additional expense and the determination of the most economical arrangemnet of height of reservoir, size of pipes and spacing of hydrants is a matter for careful study. The rule adopted in many places to put in no street main less than 6 inches in diameter in most cases works out properly but there is no excuse for it as an arbitrary rule. A short street will many times be better served with a 4-inch pipe than other streets in the same system with 6-inch mains and the money saved by using the smaller pipe could well be expended in strengthening those parts of the system which are weaker. The standard should be the quantity of water the pipe will deliver and the head under which it delivers this amount. If a 4-inch pipe will do this satisfactorily, there is no good reason why it should not be used.

The loss of head due to friction in a 6-inch pipe which has been in the ground for some time, when water is being drawn at the rate of 300 gals. per minute, is about 10 feet per 1,000 feet of length, and this figure, together with the required pressure at the hydrant of 50 lbs. per square inch should, in general, determine the allowable length of 6-inch pipe as a dead end.

The maximum desirable pressure is a matter on which there is much disagreement, but the limit is constantly being extended. If it should prove to be more economical to have a system where the pressures run up to 150 lbs., there would seem to be no good reason why this should not be done in a new system of waterworks and it would be likely to prove much more satisfactory than to maintain two levels. In 86 small towns in Massachusetts the average static pressure in the central portion of the town is 79 lbs. per square inch. Nine of these towns have pressures of less than 50 lbs.; 33 have pressures of from 50 to 75 lbs.; 31, from 75 to 100 lbs. ,and in 13 the pressure is more than 100 lbs.

Pumping Engines.—The development of the oil and gasoline engine has done much to make waterworks systems for small places financially possible. When the only available pumping machinery was the steam pump, the cost of installation of pumps and boilers, the cost of the pumping station to house them and the cost of maintaining the plant made waterworks practically out of the question unless a gravity supply could be secured. With the new form of engine, however, the conditions are quite different. The cost of the machinery has been greatly reduced, the cost of the station is much less and the cost of operating is reduced to a minimum on account of the fact that with oil or gasoline there is no consumption of fuel except while the work is being done, while with a steam plant a large proportion of the coal is used in banking the fires and getting up steam. Electricity is also becoming an important factor in connection with small pumping plants, although the cost of current is so great (in New England) that there are few places where oil or gasoline are not more economical, except for auxiliary plants used only occasionally.

Pumps should usually be designed for the greatest economy in doing the work which they are called upon to do regularly in supplying the domestic needs of the town, without regard to their use for fire protection purposes. It is seldom feasible in the small system to have pumps of sufficient capacity to be of very great value in case of fire, and dependence for fire protection should be placed on water stored in a reservoir or large stand-pipe or tank, or on some connection with factory pumps through which a large supply of water can be quickly secured. With increased size of pumps it is necessary to have a larger force main, a larger suction pipe, more wells, if the supply is taken from driven wells; in fact, a considerable portion of the plant must be increased in size and made more expensive in order to operate large pumps. Large pumps are somewhat more efficient than small ones and if an attendant remains at the station while the pumps are in operation there is a saving in the shorter hours required with the large pump. With the oil engine, however, or with electricity, constant attendance is unnecessary, especially in the case of the smaller plants.

Pumping machinery should always be provided in duplicate, and works, although designed to run most economically when one unit is in operation, can be operated, if necessary, at double capacity with a somewhat reduced efficiency. A plant designed for a community which will use from 100,000 to 150,000 gals. per day, should generally have a capacity of about 250 gals. per minute for each unit. This would mean the operation of one of the pumps for from six to ten hours each day. Such a plant would give two large fire streams in case of fire by starting both of the pumps. Many pumping plants are undoubtedly of too large capacity for economy and the tendency in recent years has been to make them smaller, especially when the power used is some form of internal combustion engine.

Distributing Reservoir.—The design of the distributing reservoir is affected chiefly by the topography, the requirements for fire protection and by facilities for pumping. In a much less degree it is affected by the consumption of water. The effect of the topography upon the design is generally to change the reservoir from what is desirable to what is practicable. In a comparatively flat community it is practically impossible to store as much water at so great an elevation as is desirable and in such cases the distributing reservoir must be cut down and other portions of the system must be designed to do the work which should properly be done by the distributing reservoir.

When the topography is such that it is feasible to build a reservoir of any desired size and any height, the design is dependent almost entirely upon the requirements for fire protection. Generally it is found that the desirable statis pressure from the reservoir point where there is likely to be the greatest demand for water is from 80 to 100 lbs., depending to a large extent upon the distance from the reservoir to the center of distribution. The reservoir should be, if practicable, large enough to hold at the required elevation, in addition to the domestic supply for 24 hours, a sufficient quantity of water with which to fight any fire which is likely to occur. A fire in the built up portion of a village may take about 1,000 gals. per minute or 60,000 gals. per hour. In general, the time during which this quantity will be required will not be more than from two to four hours. Applying this rule to the ordinary town with no large fire risks, the capacity of the reservoir or standpipe should be from 300,000 to 400,000 gals.

Pipe Thickness.—The part of the design in which theory plays the smallest part and in which even experience is likely to count for little is in the determination of the thickness and weight of cast iron mains. The static pressure which pipes have to withstand and the breaking strength of the cast iron are the only elements in determining the proper thickness of the pipes which are even approximately known, and determining the thickness from these elements alone would give pipes of about the thickness of cardboard.

The formula used by the New England Waterworks Association is:

$$t = \frac{pr}{1/5\ (16{,}500)} + \frac{p'r}{1/5\ (16{,}500)} + 0.25$$

where t is the thickness of the shell in inches; r is the radius of the pipe; p, the static pressure in pounds per square inch; p′, an assumed water hammer in pounds per square inch; 16,500 is the breaking strength of cast iron; and 5 is a factor of safety.

The chief uncertainties in the determination of the proper thickness of pipes are the water hammer, the effect of corrosion, the possibility of breakages in handling, the strains due to imperfect foundations or unequal settlement and the eccentricity of castings and other imperfections in the pipe. There is no reason why the water hammer in a small system should not be kept below the figures ordinarily used in the formula. There are few, if any, authentic cases where corrosion of a cast iron pipe has caused its failure. In fact, if a pipe has been in the ground long enough to corrode, it seldom fails from any cause. The strains due to imperfect foundation and settlement, in the case of small pipes, can be neglected if proper precautions are taken during construction. The difficulties due to imperfections in the casting and to the handling of thin pipes are the most serious and to overcome these is the duty of the founders. That they will be overcome, if the engineers insist on light pipe, there is no doubt, for already much has been done along these lines; the cost per ton may be somewhat increased if lighter pipes are used, but this increased cost will be nothing like the saving accomplished by the use of the lighter pipe.

In my own practice, I have put in many miles of Class C pipe where the pressures run up to 115 lbs. per square inch and have never known of a failure which would have been prevented by using thicker pipe.

Depth of Cover for Pipe Lines.—The depth to which street mains should be laid has been investigated by a special committee of New England Waterworks Association, see report presented at November, 1909, meeting, and the experience of the cold winter of 1911-12 has given valuable experience to those who have had charge of waterworks. The depth determined on affects the cost of the works materially, especially if rock is encountered, and if it is safe to reduce the depth it certainly should be done.

Theoretically, street mains might be laid at different depths in indifferent soils, being a foot nearer the surface in clay than in gravel, but in the average New England town there are so many soils that it is not wise to make any distinction. The only discrimination which it would appear safe to make is in the case of places where the ground water always stands near the surface, where the pipes may be laid in shallow trenches. The freezing of the pipes is such a serious matter that it would seem to be unwise to take any chances in an attempt to save money on trench excavation. The best practice seems to be, for a climate like that of Massachusetts, to have the center of the pipe from 4.75 to 5 ft. beneath the surface.

High Standard of Exhibits at Toronto

Great National Show at the Queen City Marked by Many Advances in the Displays of the Constructional Interests

ALL things considered, the Thirty-Sixth Annual Exhibition in connection with the Canadian National Exhibition Association, which opened at Toronto on August 29, has proved most successful. The display generally reached a very high standard and the exhibits representative of the industrial enterprise of the Dominion were creditable alike to the manufacturers and to the Exhibition executive. It is hardly necessary to expatiate upon the part that the Canadian National Exhibition plays in the development of the country, in bringing all sections of the people together on a common basis and enabling each to profit by the results of industrial and business enterprise.

The exhibits identified with the field of the Contract Record provided exceptional interest for exhibition visitors. Below we refer briefly to a number of the more prominent exhibits.

The Hoidge Marble Company, dealers in domestic and foreign marbles, exhibited some excellent specimens of their marbles in the Government Building.

W. D. Beath & Sons, Toronto.—This company had an important outside exhibit which comprised an extensive line of switches and overhead tracks as well as a variety of derricks, both of which are hand-power operated.

B-O-T Manufacturing Company, Limited, Toronto.—This firm exhibited their B-O-T guaranteed water closet outfits, special attention being drawn to the construction of the lock-dovetail where each tenon of the joint is a real wedge.

The Dominion Sewer Pipe Company, Swansea, Ont.—This firm had a well-arranged display of sewer pipes. They also exhibited other well-known lines of chimney tops, wall coping, culverts and inverts which attracted favorable notice.

The Consumers Gas Company, Toronto.—Lighting fixtures are always a strong element of attraction and this year's exhibit of the Consumers Gas Company drew large crowds to examine the handsome display of lighting fixtures, which they did with much interest.

The Dominion Belting Company, Limited, Hamilton, Ont.—This firm showed a full line of "Maple Leaf" products, which embraced an attractive display of Maple Leaf brand stitched cotton duck belting. "Crescent" belt fastening was also demonstrated at this booth.

The Wm. Peace Company, Limited, Hamilton, Ont.—Had an attractive display of the "Peace" patent improved metal weather strip for windows and doors. The metal is claimed to be both wind and dust proof and is made in four different products, zinc, brass, copper and bronze.

The H. Mueller Manufacturing Company, Limited, Sarnia, Ont.—This firm had an interesting display of plumbing, waterworks and gas appliances. Amongst the principal lines shown were the Mueller water meter testers, which are made complete in two sizes, also the tester tanks, made specially for use with Mueller water meter testers and the Mueller truck for moving large meters to and from a tester. Other lines include reducing and regulating valves and pump governors. Their Colonial self-closing faucets were a no less interesting feature of the exhibit.

A. Ramsay & Son Company, Montreal.—Had an interesting display of paints for exterior and interior work. The Ramsay's white lead for exterior work is a line which the firm emphasizes to contractors on the ground that it has been proved to withstand successfully the test of time.

R. A. Lister & Company, Limited, Toronto.—Had an interesting exhibit of electric generating plants which included their direct running, automatic or storage battery sets, particularly the 6 kw. generating set. Many of these latter are in use in connection with contractors' plants.

The Bateman-Wilkinson Company, Limited, Toronto—Drag and wheel scrapers, road plows and contractors' barrows, filled a conspicuous place in this firm's exhibit of contractors' supplies. The collection, which also included several other lines, made a particularly noteworthy exhibit.

The Waterous Engine Works Company, Limited, Brantford, Ont.—A special feature of this firm's exhibit this year were their steam road rollers which are so well-known in every part of the country where they have been introduced. A line in their "trouble-proof" pumps was also shown.

The Standard Ideal Company, Limited, Port Hope, Ont.—Had an interesting display of bathroom and toilet fixtures, including the Victor one-piece bath, enamelled all over. Amongst the high-class buildings fitted with this type of bath is the Vancouver Hotel, built for the Canadian Pacific Railway.

The John Deere Plow Company of Welland, Limited.—The exhibit of this firm included a number of drag scrapers, road plows and contractors' barrows. The popular new short coupled Watson dump wagon occupied a prominent place in the exhibit and drew much favorable comment from interested visitors.

The Canadian Fairbanks-Morse Company, Limited, Toronto.—Displayed types of their well-known gasoline engines such as are used with their M-C rail track paver. These engines are specially built for operating the standard mixers and their many commendable features were the subject of much attention.

The Standard Sanitary Manufacturing Company of Canada, Limited, Toronto.—This firm's booth in the Process Building was replete with plumbing fixtures in great variety, also sanitary appliances. In regard to the latter, a couple of complete bathrooms and toilets were shown. These proved of great interest to many visitors.

The Pedlar People of Oshawa, Ont.—A strong line of sheet metal products from their factory, claimed to be the largest of its kind in the British Empire, was exhibited by the Pedlar People of Oshawa. Their "Perfect" steel and metal shingles came in for special notice and their corrugated steel sheets for roofing and siding formed an interesting display. A model dwelling, illustrating the high value of the firm's products, combined with the comparative inexpensiveness of construction, was exhibited on the grounds, its general attractive appearance winning universal commendation. Pedlar's "Perfect" culverts, made of anti-corrosive "Toncan" metal, also form part of this interesting exhibit.

The Jas. Morrison Brass Manufacturing Company, Limited, Toronto.—Exhibited their J-M-T standard reducing valves for reducing high pressure steam to the low pressure required for such apparatus as is used in heating, dyeing, boiling and drying. The exhibit also included recording pressure gauges and corporation service brass works.

The Dunlop Tire & Rubber Goods Company, Toronto.—An attractive booth in the Transportation Building was that of the Dunlop Company, whose exhibit of all kinds of fire hose and rubber tires was commendable. The exhibit included the well-known traction tread clincher tires, also tires suitable for heavy motor trucks.

Mackintosh Hutchinson, Toronto.—The exhibit at this booth was the Hutchinson Combination woodworker, a machine which is claimed to be an important labor and money saver for builders and contractors. An interesting feature of the exhibit was a portable contractors' saw, which was demonstrated to the satisfaction of many visitors.

The Dennis Wire & Iron Works, Limited, London, Ont.—Dennisteel products made a commanding display in the Process Building. Lockers, bins, racks, tables and benches, partitions, etc., of steel construction attracted much attention, the advantage of unit construction being demonstrated to visitors. This firm also have an important line in fire escapes.

The Star Expansion Bolt Company.—Had an interesting display of Sebco products, including Sebco expansion bolts, single and double types, chair expansion bolt drills, and the Star Toggle bolt. Star drills, which are especially adapted for drilling clean-cut holes for the Star Toggle bolt, were also on display. Mr. H. F. McIntosh, Toronto, is the sales agent.

Batts Limited, West Toronto.—As manufacturers of staved columns, veneered and pine doors, newel posts, trim and interior fittings, etc., Batts Limited are well-known in the building and contracting world. The firm had a very pleasing display of stave columns, showing lock joint pilasters, doors of all kinds, besides attractive examples of panelling and other interior work.

The Ontario Marble Quarries, Limited, Bancroft, Ont.—Among the exhibits of Ontario's mineral wealth which occupied a place in the Government Building not the least conspicuous was the display of marbles made by this well-known firm. The attractive combination in the coloring of the different marbles was demonstrated in a model house front erected in the building.

The Asbestos Manufacturing Company, Limited, Montreal.—The exhibit of this well-known firm comprised the popular asbestos cement shingles, cement sheathing, Asbestoslate and Linasbestos building board. This building board, which is claimed by the makers to be the only absolutely fireproof cheap building board which can be used as a finished surface, is a composition of asbestos and Portland cement, of cement color with a pinkish tinge. A handsome residence was exhibited on the grounds by way of demonstrating the combination of artistic beauty and practical utility of the material, when judiciously used in the interior. Among the prominent buildings to which Asbestoslate has been applied as a roofing material in Toronto are the armoury, University avenue, and the Government Building, Exhibition grounds. Many high-class residences have also been roofed with Asbestoslate and Asbestos Cement shingles.

The Cleveland Pneumatic Tool Company of Canada, Toronto.—An interesting display of air tools, which included air drills of the ball-bearing type, reversible and non-reversible, was exhibited by this firm. Several samples of air hose couplings of the Bowes automatic type occupied an important place at the booth, also the "Neverslip" clamps which connect hose to couplings.

Nash Temperature Control, Limited, Toronto.—This firm demonstrated the Nash system of automatic temperature control by compressed air or vacuum. The Nash system is claimed to be applicable to every form of ventilation, never allowing a room to become too hot or too cold. It is a simple temperature control, being only 6 ins. over all and is claimed to be indestructible.

The Tuec Company, Toronto.—This firm demonstrated the Tuec Stationary Vacuum cleaner, the outstanding qualities of which are claimed to be simplicity, economy and durability. The demonstration naturally drew large numbers of interested spectators who were anxious to see the Tuec machine in motion. The efficiency and dependability of this machine is too widely known to call for commendation here.

The Consolidated Optical Company, Toronto.—This firm are the manufacturers of transits and levels as used by the engineer, surveyor, architect and builder. Their line of Consol surveying and engineering transits and levels attracted particular notice. The 14-in. Consol engineer's dumpy level, also the Wye level were also exhibited. The products of this firm are made in Canada. The T. Eaton Company, Limited, Toronto, are the Sales Agents.

The Prest-O-Lite Company, Inc., Indianapolis, Ind., the Canadian main office of which is in Toronto, exhibited their high-class oxy-acetylene process which is a widely known portable welding outfit. Some of the main characteristics claimed for the Prest-O-Welder are its portability, economy, convenience, safety, ease of control and durability. The company also exhibited the Prest-O-Flare lamp, a portable outdoor light for contractors, etc., which attracted special notice.

Canadian Independent Telephone Company, Toronto.—The Lorimer Presto-Phone system, an automatic telephone system for inside service, was exhibited by this company and included the Presto-Phone switch. The main advantages claimed for this system are compactness of switchboard and telephone, simplicity of operation, and absolute secrecy of service. The system is claimed to be especially suited for manufacturing plants, municipal and administration buildings, as well as hospitals and colleges.

Automatic Fire Detectors, Limited, Toronto.—The importance of detecting fire in its infancy has been realized by this firm, whose exhibit and demonstration came in for much attention. The Automatic Fire Detector consists of a small circular white enamelled wooden base about 4 ins. in diameter, on which is a neat nickel frame. Inside the frame is a sensitive metal spring. It is very simple in construction and so sensitive in its application that it should prove of immense service to architects and contractors.

The Sawyer-Massey Company, Limited, Hamilton, Ont.—Some excellent types of road machinery and contractors' supplies were shown at this booth. Their new model solid steel crusher has absorbed a good deal of attention on the part of contractors, as also has their No. 10½ crusher with roller-bearing truck. These contractors' requisites are manufactured in twelve different sizes to suit the varying requirements.

Sasgen Derrick Company, Toronto.—A wide range of contractors' derricks. The exhibit demonstrated a number of noteworthy improvements over the old style in the various makes. Sasgen circle swing steel derricks, double boom wheelbarrow derricks and Sasgen stiff legged derricks came in for particular attention as embodying lines of increasing popularity in the constructional field.

The Page Wire Fence Company, Limited, Walkerville, Ont.—This company had an interesting exhibit of concrete wire reinforcement for concrete road pavement, bridges and building floors. The firm are the originators of Page wire reinforcement in flat sheets which is claimed to be coming into universal use wherever introduced. The standard mesh is supplied in different sizes for road pavement and also for bridges and building floors.

The Black Building Supply Company, Limited, Toronto.—Some very handsome terra cotta work, manufactured by the Northwestern Terra Cotta Company, Chicago, adorned the walls of this exhibit. Examples of architectural terra cotta shown included various grades of vitreous face brick including Hy-tex. One of the special lines of the company this year is the Covert damper and the Underwriters fire scrupper—a very heavy and up-to-date type. Salt glazed tile, with which the floor of the booth was paved, is another of the company's special lines.

Geo. B. Meadows, Toronto, Iron, Wire and Brass Works, Limited.—This company had a very attractive booth in which they exhibited various samples of their ornamental iron, bronze and brass works and metal lockers. An interesting feature of the exhibit was a beautifully executed panel as an example of their bronze work, also a spiral stairway. The Meadows metal lockers, adaptable to all classes of buildings and fitted with the new Sure Grip triple locking device, occupied an advantageous place in the market.

The Bishopric Wall Board Company, Limited, Ottawa, Ont.—Had an excellent showing of lath and stucco boards for interior and exterior use. This wall board is claimed to be equally suitable for schools, residences and stores, being non-inflammable, weatherproof and comparatively inexpensive. The well-known Bishopric sheathing has reached a noteworthy place in the equipment of contractors, mainly because of the ease with which it can be applied and also because of the excellent panelling effects where the material is used in residences.

The Stromberg-Carlson Telephone Manufacturing Company, Toronto.—Demonstrated the practical value of the Inter-Comm-Phone system—desk type and wall type. By this system the company claim that three distinct conversations may be carried on over a six-station Inter-Comm-Phone without interfering with each other, owing to a separate pair of wires going to each station from every other station. The company have installed the system with success in many large factory and other buildings, including that of the Office Specialty Manufacturing Company, Newmarket, Ont.

The Brantford Roofing Company, Limited, Brantford, Ont.—Had an unique exhibit of their well-known roofings. In addition to their well-known ready roofings, Climax sheeting, insulating paper and building papers of all kinds were also shown. The Brantford Asphalt sheet shingles were an interesting display and received the favorable notice of a large number of exhibition visitors. The firm's paints included the "Roof-Leak" paint, also the Superior roof coating, which is applicable to cement, metal, steel and woodwork. It should be mentioned that asphalt shingles are one of the latest products of the Brantford Roofing Company. They are manufactured in three different colors, red, green and white, and several important buildings are at present being covered with the material.

The Northern Electric & Manufacturing Company, successors to the Imperial Wire & Cable Company—Had an exhibit of much interest to engineers and architects. It included the "Imperial High-grade" rubber insulated wire. The company have standardized three grades of rubber compound for rubber insulating conductors—"Adanac Imperial," "High-grade" and "30 per cent. Para." These wires are made to exceed the requirements of the National Board of Fire Underwriters, and are used principally for wiring buildings. Amongst the latter which have been wired with this firm's material are the Ritz-Carlton Hotel, Montreal, the Chateau Laurier and the Union Station, Ottawa, the Electric Railway Chambers, Winnipeg, and the Parliament Buildings, Regina. The Northern Electric Inter-Phone, the key-note of which is claimed to be simplicity of operation, was also demonstrated at this booth.

Clamps for Splicing Reinforcement

THE idea still seems to be prevalent in some localities that satisfactory splices of reinforcing bars in tension can be made by the use of clamps, thereby reducing the amount of lap (excess material) required to a minimum, in spite of the fact that tests have shown that such splices are not capable of properly developing the bars, no matter what the style of clamp. The only way to develop the strength of reinforcing bars is to lap them a sufficient distance so that the stress may be transferred from one to the other by bond, for beam tests show that the slip of reinforcing bars in tension marks the beginning of the beam failure.

Tests on bars spliced with clamps of various types show that an amount of slip sufficient to destroy the bond between concrete and steel takes place in practically all cases before the clamps come into action, and their purpose is therefore defeated.

In many cases where long bars are required and splicing must be resorted to, it is advantageous to clamp the ends of bars to be spliced, in order to facilitate holding them in position. When this is done, the bars should be lapped a sufficient distance to develop their strength in bond, no reliance being placed on the clamps to transfer stress. The bars should also be separated at least two diameters, centre to centre, at the splices, in order to allow the concrete to completely envelop the bars.

Canada the Chief Source of Asbestos Supply

CANADA is the world's chief source of supply of asbestos. Activity in the production of asbestos in Canada in 1913 was confined to the districts of Black Lake, Thetford and Danville in Quebec. None of the quarries formerly operated at East Broughton were worked, although small shipments were made by one firm from stock. The output and shipments in 1913 exceeded those of all previous years, the increase in sales over 1912 being 22.75 per cent. The total output in 1913 was 132,564 tons, as against 102,759 tons in 1912, an increase of 29,805 tons, or 29 per cent. The sales and shipments of asbestos fibre in 1913 were 136,951 tons, valued at $3,830,909, or an average of $27.97 per ton, as against sales in 1912 of 111,561 tons, valued at $3,117,572, or an average of $27,95. Stock on hand on December 31st, 1913, was reported as 20,786 tons, as compared with stocks of 23,288 tons at the beginning of the year. The exports of asbestos from Canada during the eleven months ending February, 1914, were 94,926 tons, value $2,579,448.

The Province of Quebec contains the principal asbestos-producing areas of Canada. The present workable deposits lie scattered through the great serpentine range which strikes through the townships of Broughton, Thetford and Coleraine. The total length of this belt is 23 miles, with a width varying from 100 feet in the extreme easterly part to 6,000 feet in the Mock Lake area. The principal deposits occur at Thetford, Black Lake, Danville, and East Broughton, the first two being the most important. The deposits are worked by open quarrying, the long-fibred asbestos of the larger veins being easily separated out, while the smaller material is carefully cobbed. This separation was at first accomplished entirely by hand, but mechanical treatment has been gradually introduced and perfected, until now large mills are in operation in which the rock is broken and crushed in various ways, and the fiberized asbestos is taken up from screens by suction fans, and blown into collectors or settling chambers. The annual production is now over 100,000 tons, valued at upward of $3,000,000. It includes a wide variety of grades, from the long-fibred crude asbestos, valued at $300 a ton, down to the shortest mill fibre, valued at only $2 or $3 a ton, and "asbestic sand," used for wall-plaster, and valued at from 75c. to $1½ a ton.

Puddling or Ramming Concrete After Placing

WHEN concrete first came into use, dry mixtures were used almost exclusively, and, in order to obtain compact and dense concrete, considerable tamping was necessary. Times have changed, however; and nowadays nearly all concrete mixed for placing in forms, except that placed under the direction of students of the "old school," is mixed wet, and ramming or tamping dispensed with entirely, the mixture being churned or puddled just enough to remove the entrained air.

Still, we occasionally hear of some superintendent, inspector, or engineer in charge of construction work, demanding that concrete, even if it is wet, be placed in six-inch layers and thoroughly tamped. With such concrete, tamping defeats its very purpose, for the top will be flooded with water mixed with pure cement, thus robbing the concrete of cement and reducing its strength, and making the concrete of a non-uniform mixture by forcing the large aggregate to the bottom. A wet mixture of concrete such as can be spouted by gravity should never be tamped or rammed with heavy tools; stirring, spading, or puddling with forks, spades, or rods is all that is required to allow the entrained air to escape and the voids to be filled. When wet concrete is used, it is also very important to see that the concrete be placed or poured in such a way as to prevent the formation of air-pockets, thus reducing the puddling or spading necessary.

Even with "dry" concrete there are dangers to be incurred by "too much tamping"—that is, by forcing the stone to the bottom and weakening the concrete by disturbing it after setting has begun. As in most work, there is a happy medium which must be struck in order to obtain the best results in ramming or puddling concrete.

When wet concrete is used, the rate of progress of the work is much more rapid than when dry concrete is used, since it can be placed in thicker layers and requires less attention in the matter of puddling if carefully placed. Wet concrete, then, it can be said, is the result of the general tendency toward the use of more economical methods in concrete construction work.

Something About Advertising

The failure of a trial advertisement has set more business men against advertising than any other factor in publicity. This is a pity when the indefiniteness of a trial advertisement is considered. A trial advertisement represents low-water mark—absolute bottom. It is not decisive. It has no more value as evidence than a first meeting with an individual who afterwards becomes your friend. Of all the advertisements in a long campaign, the first ad is the worst, though it is written by an adept. If it is written by a novice in advertising, that novice will never write a weaker one. It is like the first discord struck out of the piano by a beginner. If a student becomes disgusted with such an initial effort he will never get farther, and if a merchant abandons his advertising intentions because the first advertisement was unremunerative, he will never get farther. The first attempt at anything is valuable only as an educator. Advertising is like seed sown, it's got to have time to grow before you can reap the harvest.

If a paper, after careful examination, impresses you at all favorably, it's worth giving a fair trial. In no case should a trial ad be inserted for less than six months. If the paper is going to be a paying investment for you, it will begin to show results by that time.

There is a big difference between feeding a cow just enough to keep her alive, and feeding her enough to create a profit.

The same is true about advertising. Nine times out of ten a small advertisement inserted one or two times is simply a waste of money, while the same advertisement inserted for six or more months would have become a paying investment.

The city of Montreal has made a gratifying record in building construction this year, despite the financial depression and the war. From January 1st to August 31st permits were issued to the value of $12,158,000. This compares with $13,817,000 for the corresponding period of last year.

Clay and Shale Deposits of the Western Provinces

VALUABLE investigations of the clay and shale deposits of Western Canada, made by Dr. Heinrich Ries in company with Mr. Jos. Keele, are reported in a Memoir issued by the Geological Survey of the Department of Mines. The report, which is well illustrated, discusses in detail the physical properties of the clays found in the various districts. Dr. Ries speaks optimistically of the possibilities for the clay-worker in the West and says that this work has demonstrated the existence of a variety of clays in the several Western provinces of the Dominion. He reports:

"That there is a growing demand for different kinds of burned clay wares, will be admitted by all who are familiar with the situation in the region under discussion. Brick, both common and pressed, fireproofing, and sewer pipe are among the products most desired, but the larger cities like Winnipeg and Vancouver, are also calling for not a little terra cotta.

"The work carried on by the Geological Survey has demonstrated that the clays and shales found in the western provinces can be used for a variety of purposes, but it will be noticed that in no case has it been claimed that the clay or shale can be used for all sorts of purposes.

"That a lucrative field is open to the conservative investor and competent manufacturer, goes without saying, but here as in any other country, failure often awaits the individual or company that goes ahead blindly, without first studying the situation. There is no doubt that in several cases plants have been started apparently for the purpose of selling stock, and claims are made that the material is good for making this, that, and the other kind of product, although there appears to be no evidence to back the statement.

"Two facts are true, viz.: (1) that owing to the scarcity of local clay products, some inferior material is sometimes accepted in the market; and, (2) that on account of local conditions, such as high prices obtainable for product, it is often possible to operate deposits which it would not pay to work in other regions which are more thickly settled and easier of access, by competing concerns.

"Before a new plant is started, the ground should be carefully tested to make sure that a sufficient quantity of clay exists. This should be followed by a thorough and proper test of the material, made on samples that were properly taken.

"Last and not least, comes the selection of the necessary machinery for preparing, moulding, and drying the clay.

"If all these steps are carried out carefully, thoroughly, and competently, there should be no excuse for failure."

The report contains in the following summarized form the results of the several seasons' field work. The occurrences are grouped first geographically and then geologically.

GREAT PLAIN REGIONS

In this region between Winnipeg and the Rocky mountains, we have surface clays and shale formations. The former are the most widely used but the latter are the more valuable commercially.

Surface Clays

Those surface clays used for brick-making purposes in the Great Plains region include: (1) Lake clays; (2) river-terrace or flood-plain deposits; and (3) delta deposits.

The lake clays are irregularly distributed, of variable character, and in some cases resemble some of the representatives of the other types in their physical properties. The dark grey clay underlying the brick clay in the Red River valley is of this type, and is avoided by the brick makers around Winnipeg as it cracks in burning.

The more sandy lake clays, however, such as those around Red Deer and Prince Arthur, are used with satisfaction.

The flood-plain deposits are employed around Winnipeg and Edmonton.

In general the surface clays are silty or sandy, and often calcareous to such a degree that they give a cream-coloured product. Where not too sandy and lean they work well in a stiff-mud machine and can be utilized not only for common brick, but also for pressed brick, drain tile, and partition tile; but common brick is the chief product. Some of them have to be carefully dried to prevent cracking.

Winnipeg, Portage la Prairie, Saskatoon, and Edmonton are important producing localities.

In many districts these surface clays are the only available materials for brickmaking, and have to be used; in others they are sometimes chosen when better materials are at hand, simply because they work a little easier.

Shales

The shale formations that are available for clay working include the Niobrara, Pierre, Belly River, Edmonton, Laramie, and Miocene.

The Niobrara shale is found in both Manitoba and Saskatchewan. In southern Manitoba, near Leary, the shale is very plastic, and somewhat carbonaceous, but it has been used successfully for dry-press brick. To the northward along the eastern face of the Porcupine hills the Niobrara is found in quantities, but is often too carbonaceous to be used alone, although it could probably be mixed with other shales.

In Saskatchewan, along Lots lake north of Regina there are also extensive exposures of the Niobrara which could be used for pressed brick, and tests of the shale from this region are given to Memoir 25 now in press.

Tests made in the laboratory also developed the fact that a mixture of Niobrara and Pierre shale can be employed to make sewer pipe.

The Pierre formation, which is composed almost wholly of shales, occupies the summits of all the higher land in the western part of the Province of Manitoba.

The upper portion of the Pierre contains a considerable thickness of hard, light-grey, fine-grained shale, the lower portion being made up of softer dark grey shale, which contains crystals of selenite, and nodules of clay iron stone. It is the former that is of more value to the clay worker.

The Pierre shales are found outcropping at a number of localities in the Province of Manitoba, but about the only point where an attempt has been made to utilize them is at LaRiviere, Manitoba, where they have been worked for pressed brick.

In order to get a good product from the Pierre shale, it should be finely ground and if possible mixed with a little plastic clay, as the shale alone does not develop very much plasticity nor burn to a dense body. With care it can be used in pressed-brick manufacture. The material is not a fireclay, as often thought to be, although it sometimes shows a fusing point of cone 10 or 12.

The Belly River formation underlies a large area of the plains (See Geological Map, Memoir 24), but outcrops are scarce owing to the heavy mantle of Pleistocene material, so that it is only well exposed as a rule in the cut banks of the larger rivers like the Belly and South Saskatchewan. But even there the sections are sometimes not continuous owing to the irregular upper surface of the formation.

There is no doubt but that this is an important shale formation, and one which contains strong possibilities. The characters of the shales may be summed up as follows: (1)

usually red burning; (2) often very plastic; (3) occurrence somewhat lense-like, but lenses sometimes of considerable size; (4) fusion point not as a rule above cone 5 or 6; (5) many work smoothly through a die; (6) they usually have to be carefully dried to prevent cracking.

These shales form an important source of supply for making common brick, pressed brick, and fireproofing. More recently certain ones have been used for common earthenware.

At present they are worked only in the region around Medicine Hat, but they are accessible at other points, and the two preceding reports as well as the present one, contain tests of these shales from Bow Island, Taber, Lethbridge and vicinity, Milk Creek, near Pincher, etc.

The Laramie formation, proper, underlies a small triangular area in southern Manitoba in the Turtle Mountain region.

Farther west a second but much larger triangular area is found in southern Saskatchewan. The base of this triangle forms the southern boundary of this Province as far west as the Wood Mountain district, which is included in it.

From the apex of the triangle a narrow belt extends north-westward to a little beyond the main line of the Canadian Pacific Railway west of Moose Jaw. This area includes the Souris coal field,[1] and the Dirt Hills.

The Laramie formation has been found to contain two very contrasted types of clay deposits.

In the Souris coal field we have a number of shale deposits associated with the coal seams. These shales burn to a red or sometimes buff colour,[2] and are interbedded with coals and sandstones. Practically no attempt appears to have been made to utilize them except at Estevan.

The second type of clay is that found in the Dirt hills south of Moose Jaw. Here we have deposits of white and grey clays of truly refractory character, and associated with them are clay shales of lower refractoriness.

By using proper mixtures of the different beds these materials can be used for making firebrick, pressed brick, sewer pipe, and stoneware. The deposits represent one of the greatest clay assets of the Great Plains area, and with the construction of the Canadian Northern, south from Moose Jaw, and the Lethbridge-Moose Jaw branch of the Canadian Pacific Railway, the clays of this area become easily accessible.

Next in importance to the Laramie formation is the Edmonton formation. This underlies a belt of varying width extending from the centre of the Province of Alberta, and also extending westward from Edmonton towards the mountains.

In Alberta it is divided into two parts: (1) A coal-bearing member known as the Edmonton and likely to be the more productive of shales, and (2) a heavy sandstone formation known as the Paskapoo.

The first forms a trough, which is filled along its centre by the latter. This trough widens to the north, and also flattens, exposing a larger area of the Edmonton series than in the southern part.

The shales are found with the coal seams around Edmonton, and also up the Saskatchewan river south of there.

They are likewise well exposed to the west of Edmonton along the Pembina and Lobstick rivers, and on Wolf Creek still farther west.

Those around Edmonton as a rule give trouble in moulding and drying, and are not satisfactory, but those found to the westward at the points mentioned are well worth working, since they represent materials that can be used for common, pressed, and paving brick, drain tile, fireproofing and probably in some cases sewer pipe.

Shale exposures should also be looked for on the Red Deer river within the limits underlain by the formation, and on the Bow river near Crowfoot crossing.

A narrow belt of the Edmonton formation occurs along the foothills, and passes west of Cowley on the Crows Nest branch of the Canadian Pacific Railway, and west of Cochrane on the main line of the same road.

The Tertiary formations overlie the Edmonton series and form a broad belt extending from somewhat north of the Grand Trunk Pacific west of Edmonton, southward almost to the International Boundary.

The formation consists of shales and sandstones often alternating in rapid succession. Outcrops are scarce, as the formation is heavily and extensively covered by Pleistocene sands and gravels.

It includes the shale areas examined at Red Deer, Calgary, Sandstone, and Pincher Creek near Pincher.

Tests of the shales collected from these areas in 1910 and 1911 have shown: (1) that the formation carries a number of good shale deposits; (2) that the quantity of interbedded sandstone layers varies from point to point; (3) that different beds of the shale vary in their refractoriness, the fusion point of the different ones ranging from cone 3 to 15 ;(4) that they are usually red burning.

This is an important shale formation, and it carries material suitable for making common or pressed brick, fireproofing, and in some cases even sewer pipe. Before a plant is located, however, the property should be carefully prospected and the material properly tested.

The formation is often covered by gravel, so that shale outcrops are scarce, but in many instances the material lies at no great distance below the surface.

MOUNTAIN REGION

This includes the region bordered on the east by the Great Plains, and on the west by the Coast Range, and does not contain such extensive clay resources as the Great Plains area.

Shales of suitable character for the manufacture of clay products are rare, either because the deposits of argillaceous material are too siliceous, or else because they have been metamorphosed to a slaty or schistose condition.

There are several localities,[1] however, in which promising shale beds are known.

Beginning at the north, shale beds are found associated with the Cretaceous coals in Jasper Park, which may prove useful for brick manufacture, but they have been so little developed that no definite information can be given regarding them.

In the Crows Nest pass shales which can be employed for dry-pressed brick are found in the Benton, near Blairmore. Others found near Sentinel can be used for sewer pipe manufacture. Southeast of Blairmore still other Benton shales are known which if present in sufficient abundance are worth utilizing for pressed brick.

In the Nicola valley, there are shales associated with some of the coal beds, that could be utilized for brick and fireproofing.

Of the surface clays there are a large number of small deposits, that could be employed in common-brick manufacture. One of the most extensive is that found in the Nicola valley between Merritt and Nicola, which is adapted to brick and tile making.

The most remarkable surface clay deposit found in the mountains, however, is the vast silt deposit occurring in the upper Columbia valley and described in the present report, and for which the only use suggested is the manufacture of scouring brick. It works well for this purpose.

PACIFIC COAST REGION

This includes the territory lying west of the Coast Range, and while limited in the extent of its clay resources, contains a considerable variety of plastic materials. These may be grouped under the following heads.

(1) The shale deposits of Sumas mountain. These form an important series of varying character, adapted to the manufacture of pressed and paving brick, firebrick, fireproofing, sewer pipe and roofing tile.

There is no other locality thus far discovered in Canada which contains such a variety of materials. Two factories are using the shales at the present time.

(2) Plastic surface clays of the lower Fraser Valley. These are red-burning clays, which form the basis of a thriving brick and tile industry. They are worked at New Westminster, Port Haney, Ruskin, etc.

(3) The Northumberland shales of the Cretaceous formation on Vancouver Island. These in general represent hard and often gritty shales, which are red burning, but do not possess much plasticity. With proper care they can be made into bricks.

(4) Glacial clays on southern Vancouver Island and some of the smaller islands between Vancouver Island and the main land. These are red burning and utilized for brick.

(5) Residual fireclay, found near Kyuquot or northwestern Vancouver Island.

(6) Deposits of glacial clay scattered along the coast, and which could be worked later to supply the Prince Rupert market.

CONCLUSIONS

After having covered most of the accessible portion of the territory of the western provinces, I think it is safe to say that the different formations mentioned carry a variety of clay resources which it will pay to develop.

Personal Mention

Mr. M. A. Woods, is taking charge of the Engineering Department of the Grand Trunk Pacific, in place of Mr. B. B. Kelliher, who has resigned. Mr. Woods' headquarters will be at Winnipeg.

The latest membership list of the Institution of Muncipal Engineers (Great Britain) contains the names of the following Canadians: Mr. L. E. Allen, Belleville, Ont., Engineer for the County of Hastings; Mr. A. W. Ellson Fawkes, Waterworks Engineer, Calgary, Alta.; Mr. E. C. A. Hanson, City Electrical Engineer, Saskatoon; Mr. G. H. Hatfield, Road Engineer, St. John, N.B.; Mr. W. Murdoch, City Engineer, St. John, N.B.; Mr. G. D. Weaver, Town Engineer, Melfort, Sask.

Mr. M. A. Lyons has been appointed Chief Engineer of the Manitoba Highway Commission, with headquarters at Winnipeg. Mr. Lyons graduated from the Massachusetts Institute of Technology in 1910. He was transitman with the Halifax & Southwestern Railway during the year following, and also served as draftsman for the Coffin Valve Company. In 1911 he was made Assistant Engineer for the Canadian Pacific Railway in the Irrigation Department. In 1912 he was appointed Drainage District Engineer for the Manitoba Department of Public Works. Since 1913 Mr. Lyons has been Bridge Engineer for that department. Other engineers appointed to the Highway Commission are Messrs. T. T. Wilson, J. B. Phillips, W. Youngman, R. Whitside and F. Minnville.

Mr. B. B. Kelliher, Chief Engineer of the Grand Trunk Pacific Railway has resigned, owing to ill-health. Mr. Kelliher has been engaged in railroad construction for some thirty years. For ten years he has been actively engaged in the building of the Grand Trunk Pacific. Mr. Kelliher was in charge of the entire construction scheme for nine of these ten years. The first sod of the Grand Trunk Pacific was turned a few days after his appointment as Chief Engineer, and the last spike was driven this summer, marking the completion of the transcontinental system. Mr. Kelliher was born in Ireland and educated at Dublin University. After serving as an apprentice to a civil engineer in Dublin and being engaged on the surveys for the Mitchellstown and Fermoy and the Galway and Clifton roads, he went to the United States. From 1886 to 1890 he was with the Union Pacific Railway and from 1890 to 1896 he was assistant engineer of the Northern Pacific road on the Cascade and Pacific Divisions. He was chosen for the difficult task of locating a line through the mountains of Colorado from Denver to Salt Lake City for the Denver North-Western and Pacific Railway, and joined the Grand Trunk Pacific on the completion of this work as Division Engineer at Winnipeg.

Prospective Road Work in Ontario

It is understood that tentative plans have been made by the Ontario Government with a view to providing road work for a large number of men during the fall and winter. The largest undertaking in sight is the Toronto-Hamilton highway, which will entail an expenditure of some $800,000. The Provincial Highways Department has completed a working survey of the road, and estimates and data have been secured. The municipalities interested are all in favor of the improvement, and co-operation will open the way for construction with practically no delay. While nothing definite has yet been arranged, the prospects for activity in this field are bright.

Toronto Building Undermined by Excavators

As a result of excavations made for the new Excelsior Life Building at Toronto, the north wall of the Union Loan Company's building collapsed last week. The wall collapsed in the evening, after cracks had become more and more perceptible all day. The building had been cleared and there were no casualties of any kind, but the damage was estimated at $15,000. The contractor for the excavating is Aldophe Meyers, who is carrying out the work for Messrs. Peter Lyall & Company. It is stated that an action will be brought against the contractor. Mr. Meyers holds the City Architect's Department responsible, claiming that the work was inspected daily.

Welland Canal Operations

Messrs. Baldry, Yerburg & Hutchinson, contractors for No. 2 Section of the Welland Canal, are making good progress. It is stated that the average output of No. 2 Section is fifty trains a day of ten cars each. Each car contains from twelve to fifteen yards of dirt. Recently one of the contractors' cars broke from the train and took a dive of some twenty feet into Lake Ontario. No effort has been made to raise the car, so far, as the trestle over which it plunged will not stand the strain of the large wrecking crane belonging to the Dominion Government. The old Queenston road at Homer has been diverted pending the erection of the fine steel bridge at this point, which will be one of the largest on the great waterway. Lane Bros., sub-contractors for the Dominion Bridging Company on No. 1 Section, are erecting fifty-six feet of steel framework, which is being filled with concrete and will constitute one of the largest inside harbor piers. On No. 1 Section there are two steam shovels and two drag lines at work.

MAINLY CONSTRUCTIONAL

EAST and WEST — FROM COAST to COAST

EASTERN CANADA

The city of Peterborough, Ont., has effected a loan of $100,000 for a hydro-electric extension.

The plant of the Canada Wire Nail Company, of West St. John, N.B., is about to be put in operation.

It is probable that the Bank of Montreal will lend the city of Montreal $6,000,000 for the completion of permanent works now under construction.

The proposed registry office at Toronto will cost nearly $400,000. Motion has been made to have a by-law covering the amount introduced into council.

The Merrickville, Ont., ratepayers have carried a by-law to finance the Merrickville Power Company to the extent of $30,000 in the installation of an electric power plant.

The contract of the Toronto Structural Steel Works with the City of Toronto for the structural steel work on the new Registry Office has been confirmed at $41,000.

The marble works of A. E. McLean Company, at Athens, Ont., were destroyed by fire recently. The local press suspects incendiarism, the plant having been broken into a few days previously.

The Property Commissioner of the Toronto Board of Education is negotiating for a site of four and one-half acres on Runnymede Road, to be used as a site for the new Annette Street School.

Montreal building permits for last month totalled $1,114,745, a decrease of $1,203,927. For the year to date the total is $12,158,177, a falling off of $1,658,445. The number of permits is larger, but the average value shows a decrease.

The interior work on the new post-office which the Dominion Government is erecting at Fredericton, N.B., at a cost of $133,000 is nearing completion. The general contractors for the building are Messrs. Falconer & McDonald, of Halifax.

At Oakville, the work of erecting the new orphanage of the I. O. O. F. is proceeding expeditiously. It is hoped to have the building completed by the end of October. The orphanage, which is of solid brick and fireproof construction, will cost $60,000.

Monday next, September 14, is the closing date for the receipt of tenders for the new public building which is to be erected at Peterborough. The project belongs to the Department of Public Works (Ottawa) of which Mr. R. C. Desrochers is the Secretary.

Tenders will probably be called in about six weeks for the new station which is to be erected at Lagauchetiere and St. Monique Streets by the Canadian Northern Railway at an estimated cost of $250,000. The architects are Messrs. Warren & Wetmore, New York City.

Last week the Toronto Works Commissioner, Mr. R. C. Harris, requested the Board of Control to let him purchase $70,000 worth of paving material without advertising for tenders, so as to expedite the work. Permission was refused and the supplies will be obtained in the usual manner.

The foundations are in for the new church which is to be erected on Grace Street, Toronto, for St. Francis (R.C.) parish. The new building will be 80 ft. by 160 ft. in dimensions, of stone, steel and brick construction. The architect is Mr. A. W. Holmes, and the general contractor is Mr. R. Sheedy.

Foundation work is in progress on the $100,000 apartment house which is to be erected at Bay and Herkimer Streets, Hamilton, Ont. The building will be six storeys high, 125 by 65 ft. in dimensions, of reinforced concrete and fireproof construction. The architects are Messrs. Stewart & Witton, Hamilton, Ont.

It is expected that by the end of the year the Canadian Northern Railway direct line from the west, via North Bay to Ottawa and Quebec, will be finished. There still remains forty miles of road unconstructed east of North Bay. The company anticipate a busy winter and are rushing repair work between Toronto and Port Arthur.

The Dominion Chain Company are proceeding with the erection of their factory at Niagara Falls. The new building is two storeys high, 100 ft. by 440 ft. in dimensions, of stone, steel and reinforced concrete construction. The general contractors are Messrs. Austin & Sons, Cleveland, and the architect is Mr. E. D. Pitt, Niagara Falls, Ont.

At Halifax, while no extensive building work was started last month, good progress was made in operations under way. Railway terminal work continues, and the pier contractors are erecting temporary buildings for their machinery and plant. The Dalhousie library building and the city market building are under way. Residential work is fairly active.

The Dominion Government have practically concluded an arrangement with the representatives of the Grand Trunk Pacific and the Canadian Northern by which advances will be made the two companies sufficient to let them proceed with the completion of their transcontinental lines until the bonds for that purpose, guaranteed by the Dominion Parliament, can be financed.

Operations on the new waterworks scheme at North Toronto are progressing rapidly. The foundation of the pumping station is in, and the laying of the eighteen-inch steel intake pipe is well under way and will be completed in six or seven weeks according to the contractor, Mr. J. F. Curley. It is expected that the whole system will be completed and in operation by the middle of November.

From St. John, N.B., comes the report that the western half of the new spandrel arch bridge over the Reversing Falls is now finished and the remaining portion of the work is in progress. Upon the completion of this bridge it is expected that there will be greatly increased development at Lancaster and West St. John. Already, in anticipation of its completion, considerable residential work is in progress.

Exterior work on the Old Peoples' Home, now under construction at St. Laurent (Montreal), is nearing completion. The roofing work is now in progress. The building is to be three storeys high, 200 ft. by 80 ft. in dimensions, of reinforced concrete construction. The architect is Mr. A. Piche, and the general contractors are the Atlas Construction Company, Montreal. The estimated cost is $250,000.

Considerable progress has been made with the extensive pulp and saw mills being constructed at Chandler, P.Q., for the St. Lawrence Pulp & Lumber Corporation. Twenty-five miles of railroad have been graded and 15 miles of track laid, while another ten miles is in course of being laid. The pulp mill is nearing completion. The company's town-site is practically finished, there being between sixty and seventy houses occupied. In addition, new houses are being erected by tradesmen and labourers.

According to a dispatch from Charlottetown, P.E.I., work on St. Dunstan's Cathedral is progressing very satisfactorily—"although it is delayed," we are told, "by lack of men. One hundred and ten men are now employed, but the contractor could find work for many more." Progress on the building has reached the roof, which is now almost covered. The height of the building from the ground to the top of the spire is about one hundred and seventy feet. The general contractors are the John S. Metcalfe Company, Montreal.

It is now three months since the Maritime Dredging and Construction Company took over the contract for the West Side piers at St. John, N.B. In that time much work has been accomplished, with dredges, reclamation plants and concrete mixers. About five hundred men are now employed. Nearly all the concrete face of one pier has been completed, and good progress has been made with the two piers below. There are 90,000 yards of filling yet to be done, but at the rate of progress that is being made this filling will be completed in good time for this season's work. A temporary wooden warehouse, 80 x 350 feet, will be placed on Pier 14.

Tenders for the proposed High School of Commerce, at Toronto, exceeded the amount voted by some $13,000. The Board of Control will recommend Council to pass the additional amount. The original estimated cost of the building was $250,000. Following are the principal contracts awarded last week: masonry, Messrs. R. Robertson & Sons, Limited, Toronto, $92,681; carpentry, Messrs. Crocker & Ledrew, Toronto, $44,640; plumbing, heating and ventilation, Messrs. Purdy, Mansell, Limited, $51,809; concrete floors, A. C. Richmond, Toronto, $10,750. The building will contain three storeys and basement and will be of structural steel, terra cotta and brick construction.

WESTERN CANADA

Western press reports state that a brass manufacturing plant is to be established at Redcliff, Alta.

At Regina, operations are well advanced upon the new $45,000 block which is being erected for Mr. E. McCarthy according to plans prepared by Messrs. Storey & Van Egmond.

It has been decided to take fresh tenders for the drill hall which the Dominion Government proposes to erect at Vancouver. The estimated cost of the new building is $350,000. The construction will be of stone, reinforced concrete, brick and steel.

The Provincial Highway Commission of Saskatoon are planning the expenditure of $500,000 on road work in the southern part of the province this fall. The work will be carried out by day labor. Mr. F. J. Robinson, Regina, is Chairman of the Commission.

Tenders for eighty-five miles of concrete aqueduct construction for the Greater Winnipeg Water District close on Saturday, September 19th. Mr. S. H. Reynolds, 901 Boyd Building, Winnipeg, is Chairman of the Greater Winnipeg Water District Sommission.

Tuesday, September 8, was the last day for submitting tenders for the new jail building which is to be erected by the city of Victoria, B.C. The tenders comprised separate bids for building construction, sanitary equipment, prison iron work, electrical equipment and mechanical and heating equipment.

Plans have been prepared for two docks which the Department of Public Works of the Dominion Government will build at Winnipeg. One dock, at Rover Avenue, will be 351 ft. long and 30 ft. wide, and the other, at Notre Dame Avenue, 57 ft. long and 30 ft. wide. Open pile construction will be employed.

Nearly seven thousand men are employed in the construction of the Pacific Great Eastern Railway between Chekamus and Fort George, B.C. Track-laying is in progress beyond Chekamus, where a number of bridges have been completed. Practically all the grading has been finished between Squamish, B.C., the ocean terminus of the line, and Lillooet, B.C.—a distance of one hundred and twenty miles.

Announcement is made by Sir Donald Mann, vice-president of the Canadian Northern Railway, that it is the company's intention to complete the transcontinental line as quickly as possible, despite the chaotic conditions brought about by the war. At the time of writing, Sir Donald is in Victoria, B.C., conferring with Premier McBride. The Canadian Northern Railway has three thousand men employed in British Columbia. These men will be kept at work until the rail-laying is finished.

Montreal Exchange Sets Example

The Secretary of the Montreal Builders' Exchange has circularized the membership with a view to drawing attention to the local building situation and devising means of improving existing conditions. He points out that there should be at least another two months of outside work and that if operations are closed down at this early stage it will result in a winter of unparalleled hardship for the working classes. Supply houses and contractors are asked to cut their profits to a minimum.

No Advance In Pedlar Products

The Pedlar People Limited, Oshawa, express agreement with the principles of the article, "The European War in Its Relation to Canadian Trade," published in the Contract Record of August 26 and state that they will be pleased to furnish at no advance in price their corrugated culverts for use in connection with road work, should the province or any of the municipalities decide to employ men in this department of activity during the present emergency. They state that the offer is made notwithstanding an advance in price of the raw material. It is pointed out that such road work will provide work for many workmen not only directly but indirectly, as it will tend to maintain factory labor.

In the editorial article to which reference is made, it was shown how the present conditions should ultimately mean considerable expansion of the country's trade and how everything depended upon the exercise of courage and confidence.

The Algoma Steel Corporation, Limited, Sault Ste. Marie, Ont., are discontinuing their Sales Office at 606 McGill Building, Montreal. All material manufactured by them will be sold through their Sales Department at Sault Ste. Marie.

From the National Paving Brick Manufacturers' Association, Cleveland, Ohio, we have received advance copies of the revised edition of "Specifications for the Construction of Vitrified Brick Street Pavements and Vitrified Brick Highways." Copies of these Specifications, with booklets on the subject of brick pavement construction, will be furnished upon request.

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Alphabetical Index of Advertisers
Page 18

Vol. 28 September 16, 1914 No. 37

Principal Contents

"Business as Usual" 1151

Engineering Topics in the Old Land 1152-3
By the London, Eng., Correspondent of the Contract Record.

Letters to the Editor 1153-4

The Economy of Wide Roads 1154
By Thos. Adams

Day Labor vs. Contract Work 1155

Good News from Winnipeg 1155

Methods Employed on the Substructural Work of the C. P. R. Harrison River Bridge, B.C. 1156-9

Recent Developments in the Field of Municipal Engineering 1160-2
By F. W. W. Doane

The Design and Construction of the Bassano Dam. 1162-8
By H. B. Muckleston

Interesting Process of Manufacturing Steel Pipe... .. 1168

Refuse Destruction—The Evolution of Efficient and Economical Methods of Disposal 1169-73
By R. O. Wynne-Roberts, Regina.

Injection of Cement Grout into Water-Bearing Fissures 1174-5

John W. Doty, Montreal (Biographical Sketch) 1175

Constructional News and Notes 1176-7

"Business as Usual"

There is nothing particularly warlike in the slogan, "Business as Usual," but the principles for which it stands are playing a part in the affairs of the Empire second only in importance to the operations in the actual theatre of conflict.

The vast resources which make ultimate British victory certain were built up by men whose close attention to business was as productive for Empire as the dauntless courage of military and naval heroes.

Considering the present safety of trade routes, and having in mind the glorious achievements of British arms during the first month of the war, there is no ground for panic. There is every encouragement for work and confidence.

The general consensus of opinion is that this war will lead to the permanent advantage of British trade. In this advantage Canada must obtain a proportionate share. Events move quickly. Opportunity comes and is gone. Already British and United States manufacturers are concentrating their attention upon the chances afforded them of establishing themselves in colonial and neutral markets in certain lines of trade in which our enemies have hitherto transacted large business.

This is a time of testing. False steps at this juncture will imperil us individually and weaken us nationally in the commercial world. The qualities we must produce under test are perseverance, confidence, and stability. Perseverance will arise out of a determination to stick to the guns of commerce; confidence will assert itself naturally; stability will be maintained unconsciously.

The Dominion Government and other authorities have committed themselves to the policy of continuing public works. These public works must be supplemented by private enterprise. Sacrifice at such a time is unavoidable. It will be felt least if distributed evenly throughout the whole community. With factories running and constructional operations in progress, the sacrifice will be reduced to a minimum.

Engineers, architects and contractors—as men who control labor very largely—have a great responsibility to meet at this time. Clients disposed to abandon or hold off work unnecessarily may be upheld by intelligent argument inspired by confidence and the spirit of "Business as Usual." Every contract put in hand now, in addition to its particular value in providing labor, serves to increase the general measure of confidence; every contract postponed exercises a proportionately adverse influence.

That the pen is mightier than the sword has yet to be disproved. Time will show that commerce is the real ruler of the world.

To business—as usual!

Engineering Topics in the Old Land

The Responsibility of the Press in the Restoration of Commercial Confidence—Commendable Policy of British Government and Municipal Authorities in Providing Employment—Large Sums Available for Public Works—An Unparalleled Opportunity for the Manufacturing Interests

By the London, Eng., Correspondent of the Contract Record

London, Eng., Sept. 9, 1914

WITH a flagging interest in war bulletins, which all the fabrications of all the papers in the country cannot arrest, England is regaining her sanity. The seriousness of the war is recognized as keenly as ever, and anything like the truth is still eagerly sought; but the fourth estate has run past itself this time, and a day of reckoning is near at hand. The campaign of the respective allies has been put to the blush by the campaign of mendacity, falsification and invention at home, and the censorship which has been established (with a view, it was hoped, to the dissemination of the truth alone) has apparently sanctioned any item so long as it was false. Pain incalculable has been inflicted upon the friends and relatives of those upon active service, by the circulation of reports of decimated regiments, of huge landings of wounded, and of spurious combats. Small is the wonder that interest in bulletins (written largely in Fleet Street, and its purlieus) wanes day by day, and happy will be that time when the censor allows the truth, and the truth alone, to be printed, and the great Press of the country is thrust back into either sanity or bankruptcy, with the editors and other disseminators of false news safely under lock and key.

Trade and the Press

It may be argued that this tirade has nothing to do with the matter in hand—the effect of the war upon engineering and building construction in "the Old Land"—but it has the most important and most far-reaching influence upon it. Public opinion is both led and swayed by the Press, and there can be no full restoration of commercial confidence until scare news and catchpenny sheets are suppressed. The papers are complaining, and with truth (surprising to say), that their advertisement revenue is being reduced to nil. The "great" dailies are of course hit the worst, but the technical papers are far from escaping the undoubted slump. For this state of affairs, the former are almost wholly responsible. A newspaper is produced as a medium for the conveyance of news, of general news, of news which not only interests but is of real commercial and educative value. Such news does not exist. There are men who buy half-a-dozen papers a day, and who, after feverish consultation of the war "news" (there is nothing else) throw them one by one away. Such advertisements as do appear are simply not read, and it is a waste of money to insert them. When the war is given its due proportion of space and the life and doings of the community once more receive their due proportion, advertisers will renew and confidence will be restored. Until then, the slump must continue, and the best directed activities will fail of their full effect.

Government Sanity

Happily, sanity permeates the Government Departments, and a good augury may be drawn from the modest demeanour of the War Office in Whitehall. Here is no exhibition of bunting—not a flag waves—and the doors are guarded not by soldiers with fixed bayonets or anything of that kind but by two or three sober, stolid policemen. There is no rush, no hurry, no bustle, no show; but the work is being done and full well, too. In no direction has the Government evinced its sanity more plainly than in its recognition of the fact that, as there must be considerable distress in the country due to unemployment, it would be absurd to spend money in giving relief to those out of work when useful work itself could be provided. As regards building, the men are to be set to work in their own trade in the making good of the deficiency in housing accommodation, and a scheme embracing the expenditure of £4,000,000 is to be proceeded with without delay. As is only too well known, housing accommodation in rural districts is wofully deficient, and the good done if the scheme is carried out in its entirety will prove a valuable set off against the evils of a terrible war. The Development Commissioners have funds of nearly £1,000,000 as yet unallocated, and they are prepared to deal swiftly with any scheme submitted to them. So far as the fund itself is concerned they are unable within their statutory authority to deal with any applications for grants or loans to companies trading for profit or to individuals, but they invite suggestions, especially with regard to works of improvement connected with agriculture and rural industries (including afforestation), fisheries and fishery harbours, land drainage and reclamation, inland navigation and light railways.

The Local Government Board

The Local Government Board, too, has been doing great things. The writer has not the complete official figures before him, but there is no doubt that the number of inquiries held with a view to the granting of powers to borrow has been very large. Particulars have been gathered by him of some 97 inquiries, held in August alone, involving a total amount of considerably over £500,000 and covering works of sewerage, sewage disposal, refuse destruction, water supply, private street construction, electricity supply, paving, road widening and improvement, town planning, housing, sanitary conveniences and baths; the laying out of cemeteries, parks and recreation grounds; the extension of office buildings and town halls; and many others. Here we have in all now some £6,000,000 to be expended on works of a public nature alone, and it is pretty certain that the hope of the First Commissioner of Works, "that private individuals, companies, firms and contractors will spare no effort to follow the policy of the Government so far as circumstances admit," will be realized. Numbers of local authorities, urged on by the Local Government Board, have already held urgency meetings and have decided to carry out extensive works in the direction of those set out above, from which it is obvious that thousands of men who have been thrown out of work owing to the cessation of other industries will have the opportunity for full employment. The temporary arrest of the building trade dispute means the resumption of a wide field of activities, and it has been said that the strike was a blessing in disguise owing to the large amount of arrears which have been left to be made up now.

The Great Opportunity

What will be the ultimate result of the war upon the trade of England it is hard to foresee. The State is giving much assistance to the commercial interests of the country and everything that is possible is being done in that direction for the expansion of British commerce. But success or failure, as the case may be, rests after all with the individual manufacturer and trader. He has an opportunity now which he never had before. The competition of Germany and of Austria-Hungary is a negligible quantity even as regards neutral ports. Trade routes for England are comparatively safe, war insurance premiums have dropped, and the full continuance of business transactions has been rendered possible by the prompt action which the Government took on the outbreak of hostilities. It is for the Britisher now to pick up the business dropped by his foes (once merely his rivals) and this can be done only by energy and enterprise. Already far too many works have been prematurely shut down, far too many furnaces drawn. It is of the utmost importance that preparation be made for the boom that will follow the termination of the war, and unless work of every kind is as far as possible kept going England will be in but little better position than Germany, since both will have to start afresh. "The manufacturer," says the Financial Times, "faced with doubtful markets and uncertainty of credit, may well be tempted to shut down his works and wait for better times, rather than tempt fortune by launching out in new directions. From a patriotic standpoint, however, it is urged that the bolder policy should be pursued, and Government help might well be afforded to those who are in need of financial assistance to keep their mills and works going and are able to give reasonable security for eventual repayment." Enterprise is no longer individual; it is national; and work and not relief is what is wanted by the people. At such times as the present, good business is good patriotism, however much patriotism may be "good business" in the piping times of peace.

The Normal Course

Some scare was to be expected at first, and the voice of the dismal prophets of disaster was bound to be heard. Immediately after the declaration of war Lord Crewe said "there is no reason, so far as we are able to see, why the life of the nation should not pursue its normal course;" while Lord Lansdowne said, "it is the duty of every one of us, who has an opportunity of making his influence felt, to avoid any action which would have the effect of aggravating in any way tht general alarm and uneasiness which must inevitably prevail at such a moment as this." Unfortunately the Press, to which the ordinary individual (whose brain capacity is not very great) turns in untoward circumstances, aggravated in every way this "general alarm and uneasiness," and pursued any other than a "normal course." Even as regards construction its vision was limited to the erection of hospital accommodation for the wounded, such a thing as housing or the extension of public utility work being beyond its comprehension. Happily, it is finding its level, and the professional and business interests of the country are no longer jeopardized by its vapourings. National sanity bids fair to reassert itself, and with full restoration to health things should hum. There will, of course, be much destitution, and terrible destitution too; but it is possible to prevent its spreading to all classes of the population, and the bottom dog may be certain not only of sympathy but of material support if the nation "pursues its normal course."

Business as Usual

The following extract from a letter received last week from the London, Eng., Correspondent of the Contract Record and Engineering Review is significant and suggestive:

"A great deal of attention is being given in the daily papers here urging manufacturers to conduct their BUSINESS AS USUAL, and it would appear as if the campaign were to be successful. The country has certainly scored a 'silent' victory. Trade is booming already, and orders which would have been sent to Germany are being placed here."

LETTERS

The Deposit Cheque Upheld

Montreal, Sept. 9, 1914.

Editor Contract Record:

Dear Sir,—In your issue of August 19th there appears a letter regarding the practice of requiring a deposit cheque from contractors. This letter is signed "An English Reader." The views contained therein are so radical that it is small wonder the writer hesitates to use his own name. I feel that such views should not be allowed to pass unchallenged.

I have been engaged on a number of engineering works, large and small, both as engineer-in-charge and acting in the interests of the contractor, and have therefore had abundant opportunities to observe the question from both sides.

I am perfectly willing to admit that a deposit cheque may be a source of large expense and inconvenience to the tenderer, but such a condition is possible only when the engineer is lacking in the sense of fair play so much in evidence among members of the profession.

I know that many English firms object to being asked to put up an accepted cheque with their bids, but this practice is universal in the United States and Canada, and I have yet to hear of any American contractor who has found fault with such a procedure, as it is regarded here as one of the necessary formalities.

It may be that the moral tone of the English contracting world is so high that a deposit cheque is not required. An experience which I had a short time ago with the Canadian representative of one of the large English engineering manufacturing concerns would seem to indicate that this is not always the case. This firm submitted, through their agent here, a tender on certain apparatus. When requested to sign the contract, they refused, urging that their agent had ex-

28 (37) 1914

ceeded his authority and had quoted prices which they could not sustain. Without a tender cheque the engineer and his client would have been put to considerable expense in arranging for material from other makers, and might have had to pay a considerably higher price in the end. In this particular instance, the writer was fortunate enough to get satisfactory equipment on short notice and at about the same cost.

The illustration "in plain English" given by your correspondent is quite beside the point, as it is grossly exaggerated. All specifications with which I am familiar state that the deposit cheque will be returned to the bidder upon the execution of the contract; or, if the contract be not awarded it will be returned within a specified time. Moreover, failure to execute a contract does not necessarily mean forfeiture of the cheque. Sometimes the balance is returned, after deducting the cost of a reletting, but more often a bidder is held responsible, up to the amount of his cheque, for any difference in cost between the original tender and the price at which the work is finally awarded.

There is no question but what accompanying a bid by an accepted cheque entails some expense on the part of the bidder, but it is a definite, legitimate amount and can be covered by the price bid. This requirement also operates to keep out the irresponsible bidder—a result which I think all will agree is a desirable one.

As long as human nature is what it is, and as long as there continue to be some contractors whose moral methods are open to criticism, a deposit cheque or bidder's bond will most certainly be required. It is the only way in which the engineer can protect his client against the loss of time and money consequent upon reletting a contract—to say nothing of the possible inability to get what is required at the price of the original tender.

I, for one, am firmly convinced that the deposit cheque plays a very important part in our present system of contracting, and I believe that the majority of Canadian engineers and contractors will agree with me.

Yours truly,
R. DeL. French,
Assoc. Mem. Am. Soc. C. E.
Assoc. Mem. Can. Soc. C. E.

The Problem of Cost Data

Montreal, Sept. 10, 1914.

Editor Contract Record:

I was interested in the particulars concerning the Ottawa River water supply project, published in your issue of September 9, but I notice that no costs were given. Generally I find your journal up-to-date in reporting constructional projects, but I feel that I must take this opportunity of emphasizing the value of cost data. If it is true that an engineer is a man who can do with one dollar what any fool can do with two, it goes without saying that he attaches primary importance to costs.

Yours very truly,
W. J. Richards.

Cost data have been a hobby with us from the time the first issue of the Contract Record appeared, but in this case theory and practice are two different things. In theory the Contract Record believes in publishing itemized cost data on constructional operations great and small, but it experiences no little difficulty in persuading engineers and contractors to furnish the necessary information. There is too general a tendency to regard cost data as stock-in-trade and to blanket the really helpful details affecting expenditure.

In dealing first with this aspect of our correspondent's letter, we do so because we desire to emphasize the high value which we place upon all material likely to be illuminative from the standpoint of cost. In regard to the particulars concerning the Ottawa River water supply scheme, we had already communicated with the authorities of the Federal Capital when our correspondent's letter arrived. The text of the reply from Mr. John Henderson, City Clerk of Ottawa, is as follows: "No detailed statement as to the cost of the proposed water scheme has been submitted. The public have merely been informed that the expenditure will be within two million dollars." We are indebted to Mr. Richards for enabling us to give prominence to an important detail.

The Economy of Wide Roads

By Thomas Adams*

THE advantage of wide roads is sometimes questioned. Where they are made in advance of requirements they may impose an extra burden on the existing ratepayers, for the benefit of posterity. This burden may be too great, even having regard to the ultimate benefit which may be derived, but of course this entirely depends on the degree of width and the extent of cost incurred. No definite standard of width can be satisfactory for adoption under all circumstances.

The ultimate economic gain to the community is one factor, but it is only one factor, in giving the matter consideration. The local circumstances may make it necessary for each road to be considered on its merits. The cost of expropriating land, the existence of buildings, the physical character of the site, the immediate gain as distinct from the prospective gain to the community must all be considered. There are, however, some general principles which afford us guidance in regard to these matters; for instance, where it is definitely known that a road will be required for use as a surface railway or tramway the width of the road should of course be greater than where such use is not contemplated.

There is no necessity for a road to be actually constructed in advance of traffic requirements. On that point there need be no difference of opinion. The sole question is whether the land should be acquired or earmarked for the road in advance of the full width being required. The investment made by the community to-day for the benefit of the future citizens may therefore be limited to the acquirements of the extra land. The construction can be spread over as long a period as may be desirable, but if the land is not purchased at the outset it may be assigned to private uses, such as the erection of expensive buildings, which would make it prohibitive to carry out the widening when actually needed. These possible losses and hindrances to the future development of a town must of course be considered, as well as the question of immediate gain, but the immediate gain, or rather absence of loss, probably makes the wider appeal to the ratepayers.

It is therefore of interest to have an example such as that afforded by the illustrations and figures I am about to give with regard to the construction of a wide road at Liverpool, England. The city engineer of Liverpool has made extensive experiments in the making of wide roads round the suburbs of the city. He is probably the ablest city engineer in the mother country. Recently he demonstrated to his council that it was cheaper to make a road 120 feet wide than 80 feet wide.

The cost of the two roads, 80 feet and 120 feet wide respectively, is given by the city engineer as follows:

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* Senior Advisor to the Local Government Board of Great Britain.

CITY OF LIVERPOOL
City Engineer's Department

Comparative cost of widening a 40-foot road to 80 feet (tramways paved) with widening to 120 feet, (tramways in grass).

Widening to 80 Feet

Cost of land, 13 1/3 yds. at 5s.	£3	6	8
Street works per yard lineal	£7	2	6
Tramways (including paving) 1 yd. at £6 15	£6	15	0
	£17	4	2

equals £30, 286 per mile.

The above estimate includes for the reconstruction of the old road to suit new levels.

Widening to 120 Feet

Land for new road, 13 1/3 yds. at 5s equals	£3	6	8
Street works per yard lineal	£4	13	7
Tramways (in grass) including land, 1 yd. at £6 16 8	£6	16	8
	£14	16	11

=£26, 128 per mile.

This estimate does not include for any alteration to the old 40-foot road.

It will be observed that in order to make the 80-foot road it is necessary to reconstruct the old road to suit the new levels, but that no such reconstruction is necessary in the case of the wider road. It is also important to note that the estimate for the 120-foot road includes the cost of the extra 40 feet of land used for tramway purposes.

These circumstances are of course special to a certain extent. Instances might occur where the reconstruction of the old road would be necessary in either case. But even then the only extra cost per yard in making the wider road would be one-eighth the difference between £6 15 and £6 16 8, the cost per yard of the tramway.

In this case the important point is that it is much cheaper for the Liverpool corporation to make a road 120 feet wide than 80 feet wide. All the ultimate advantages to the city are therefore additions to the immediate gain. The latter, however, is not limited to the saving of cost. In Liverpool they are finding out that these wide tree-planted roads are having the effect of keeping the homes of the well-to-do citizens within the city boundaries. Those who will not erect large houses in narrow uninteresting tramway routes are building them on the spacious highways which Mr. Brodie is constructing. Liverpool has for a long time suffered from the migration of its large ratepayers into outside districts. This not only increases the rates all round in consequence of lowered ratable value, but removes from the city those who, while in residence, subscribe to its charities and take an interest in its social life. That the policy of making wide avenues with grass margins is helping to retain these well-to-do inhabitants within the city limits is one of the indirect advantages which Liverpool claims.

UNDER the auspices of the American Highway Association, a conference of women from all the States has been called to meet in Atlanta, Ga., November 10th, to consider ways and means of making the organized efforts of women most effective for the betterment of public roads. The programme includes a special demonstration of the government exhibit for the ladies in attendance at the Conference, upon which occasion the Director of the United States Office of Public Roads will be the host. A lecture illustrated by moving pictures will be given by Mr. J. E. Pennybacker, Chief of the Division of Road Economics.

Day Labor vs. Contract Work

MUCH municipal work has been carried out by day labor in western cities, but not always successfully or profitably. Strenuous objections to the system were brought forward by Alderman Hepburn of the Vancouver City Council recently, when the city engineer recommended carrying out considerable work by day labor. Mr. Hepburn decried day labor and stated that no more dishonorable transactions had been carried out by the city than recent decisions against contractors. In one instance the contractors were held up for two months and then the work was carried out by day labor. After that, the work cost $15,000 more than the contract price. Alderman Hepburn asserted with much reason that contractors were able to figure more closely than a corporation, owing to the advantages they obtained in the way of cheap quotations on cement and other materials. A member of the council supported Alderman Hepburn and outlined the many advantages that were associated with contract work, particularly the incentive to do the work economically and expeditiously. Civic employees had no personal concern with any additional expense. The contractor had. It came out of his pocket. In regard to expeditious work, a generous time limit on day labor was always understood and invariably exceeded. The greatest engineering and constructional operations in the world had been carried out by contract.

Good News from Winnipeg

FROM Winnipeg comes the cheering report that work is proceeding on all contracts with the exception of the provincial government jobs and the Ames-Holden building. The leading contractors are practically unanimous in saying that there has been no cessation of work on their various undertakings, which involve the expenditure of two or three million dollars. One firm has taken on four new contracts since the outbreak of hostilities, and another firm has actually increased the number of its employees. The local representative of Messrs. Geo. A. Fuller Company states that his firm has agreed to furnish the money for constructional operations at Edmonton on the University of Alberta. The Carter-Halls-Aldinger Company report that work has not been stopped on any of their contracts in Winnipeg and the west; and that, on the contrary, they have added to their staff. Among the large buildings which they have under way are the new drill hall in the west end, the addition to the Winnipeg Grain Exchange, the Quebec Bank and the Olympia building. At Calgary they have the new Merchants Bank building, and at Moose Jaw a large contract for the Canadian Pacific Railway. Messrs. Frid-Lewis & Company are proceeding with eleven contracts, four of which have been taken on since the war started. The Daykin-Scott Construction Company have two apartment houses and six residences on hand.

Methods Employed on the Substructural Work of the C.P.R. Harrison River Bridge, B.C.

THE double-tracking of the lines east from the Coast has necessitated the rebuilding of all the C. P. R. bridges. The foundations for the two largest of these, the Pitt River and Harrison River Bridges, have recently been completed by The Foundation Company, Limited. The old Harrison River Bridge, B.C., consisted of 425 ft. of standard C. P. R. trestle on the east side; one 127 ft. plate girder draw span, and four 100 ft. pony truss spans. The new bridge will consist of seven 70-ft. and three 80-ft. half deck girder spans, and one 176-ft. through girder draw span. The grade and alignment of the new bridge will be the same as the old.

The soundings showed that there were about 20 ft. of water at Piers Nos. 1 to 4 inclusive, and 22 ft. to 26 ft. at Piers Nos. 5, 6, and 7—the deepest part of the channel. Borings taken at the site of the piers showed fine sand, gravel and clay on the east side up to Pier No. 7. Here rock was found at Elev. 57.5 below extreme low water on the downstream end of the pier and 81 ft. on the up-stream end, showing a difference of 23.5 ft. in 60 ft., the length of the pier. At the site of Piers Nos. 8, 9, 10 and 11, the conditions were even worse. At the downstream end of Pier No. 9, rock showed up at Elev. 22.3 ft. and only 3.5 ft. of material overlying the rock, while at the upstream end rock showed at Elev. 57.3 ft., a difference of 26 ft. in 55 ft., the length of the pier. The material on the west side overlying the rock was a fine sand with a thin layer of clay and hardpan just above the rock. At Pier No. 11 the rock cropped out at low water but was 48 ft. below at the upstream end of the pier.

Work was started on the east side as the temporary changes required for handling traffic were more easily made when the water was high than on the west side where the pony trusses were moved and the drawspan taken out after navigation was closed on November 1st.

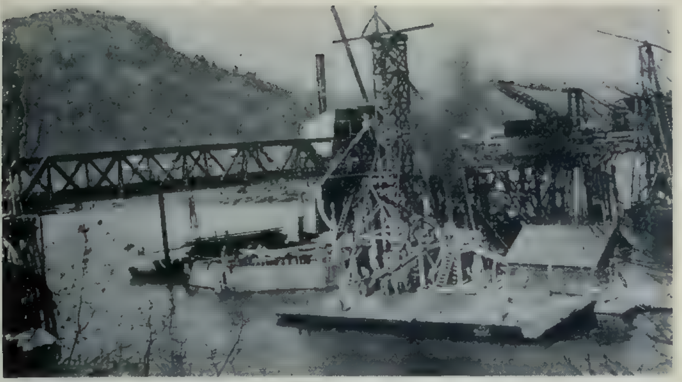
To make room for constructing the piers under the old trestle section, additional pile bents were driven 13 ft. either side of the centre line of the new piers and extra heavy stringers were used. These were six 15-in. x 30-in. x 26-ft. long. The change left two old pile bents besides a large number of stub piles, remnants of former trestles, inside of each cofferdam for Piers Nos. 1 to 5 inclusive.

General view of the Harrison River Bridge under construction.

Arrangement of Derricks

One derrick with 60-ft. boom handled the East Abutment and Pier No. 1 with one set-up. Another derrick on a platform or tower between Piers Nos. 2 and 3 handled these two piers. One between Piers Nos. 4 and 5 handled these two piers. Later a derrick tower was erected between Nos. 6 and 7. These were all on the downstream side of the bridge. On account of the trusses on the West end of the bridge, the derricks had to be raised to work over them. Owing to the fact that on the south side of the bridge there was very little ground covering the bed rock to support the piles, the derrick towers for Piers Nos. 8, 9 and 10 were placed on the upstream side. One derrick tower between Nos. 8 and 9 and one between Nos. 9 and 10 handled these piers.

The cofferdams for Piers Nos. 1, 2, 3, 4, 5 and 11 were 22 ft. by 52 ft. and were made 12 in. x 12 in. inside and outside rangers, and 6-in. specially cut T & G all merchantable fir with 10 in. x 10 in. and 12 in. x 12 in. cross braces. In general the pier sites were cleared by dredging out old logs, brush and in some cases a large number of old piles were pulled out. The river bottom was also levelled as much as possible. By means of this preparatory work the full sets of inside



Sealing open crib. Note mixer plant.

Completed piers on east side.

and outside rangers were weighted down to the river bottom in good shape before starting to drive sheeting. Corner irons were put on several sets of the inside rangers in each corner and after the skeleton was located and made fast, guide or anchor piles were driven in the corners. This gave perfect alignment and a sure anchorage. A drop hammer in swinging leads from the end of the boom was used to drive the sheeting.

The cofferdam for Pier No. 11 was made of 6-in. tongue and groove sheeting and 10 in. x 10 in. rangers, the sheeting driven to rock, cofferdam pumped, the rock cleaned and concrete poured. Some difficulty was encountered in getting down to the rock on the North end of Pier No. 11 on account of the head of water. This amounted to 28 ft. at the lowest point and gave little chance to brace the end of the cofferdam against the smooth sloping rock. The west abutment was put in when the water was extremely low, and all work was done in the dry, the rock cropping out high above extreme low water.

Excavation

The excavation in the cofferdam and the open cribs was made with a clamshell dredge. Excavation was made to a point 18 ins. to 2 ft. below the required cutoff of the piles to allow for swelling during the driving of piles. Very little jetting was required to clean up the bottoms to grade.

Piling

Fir piles (45 ft.) were used in Piers Nos. 1 to 6 inclusive, all having 32 ft. to 36 ft. penetration. In Pier No. 7 longer piles were driven in the upstream end to get the piles to rock or at least to hardpan to care for any uneven settlement that might occur on account of piles in downstream end having bearing on rock.

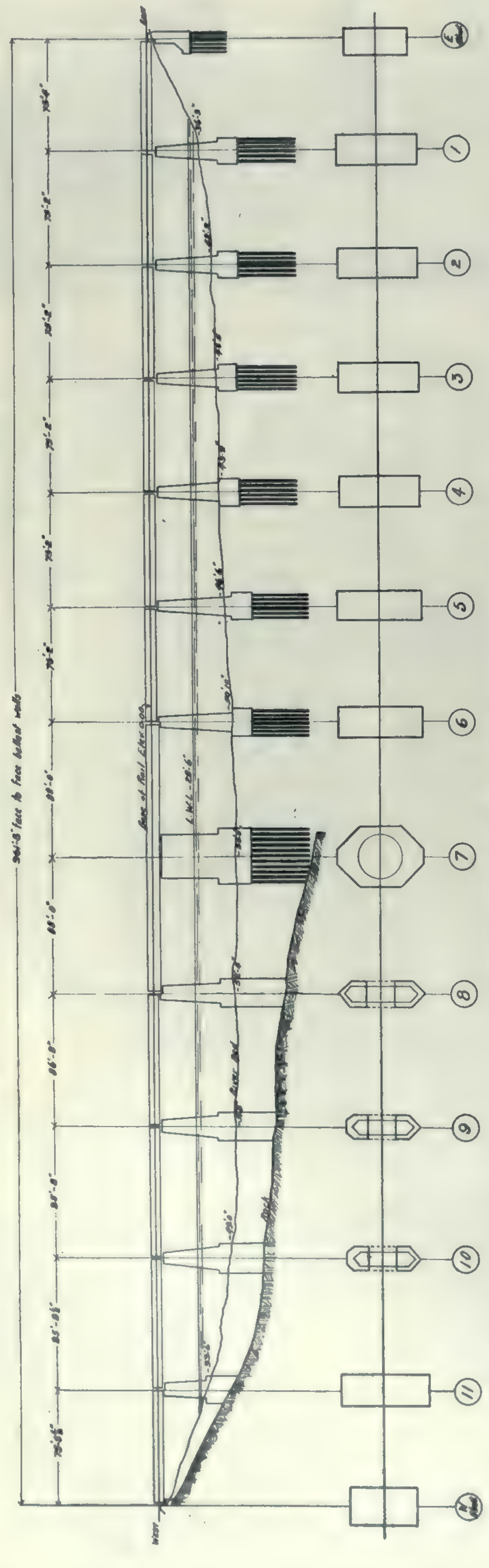
In driving the round piles in the cofferdam, a drop hammer was used in the east abutment where the driving was done in the open, and with steam hammers and Australian Gum followers for driving through the water in Piers Nos. 1 to 4. Using hardwood followers was found to be a serious problem as it was very difficult to get timber that would stand up under the hard pounding necessary to get the required penetration. The types of hammers used were No. 3 Vulcan, No. 1 Georgian Bay and No. 3 Monarch.

In the cofferdam for Pier No. 5, and in open cribs Nos. 6 and 7, the pile driving was done under water.

Open Cribs

Open cribs were used for Piers Nos. 6 and 7. The location of Pier No. 6 was in the East Channel of the old swing-span. Pier No. 7, the new Pivot Pier, was in the West Channel of the old swing-span. The design of these cribs called for solid timber crib for 12 and 17 courses, respectively, above the cutting edge and from that point 3-in. sheeting with rangers spaced as required. The solid part of the crib was framed and built up in the timber yard adjoining the site of the bridge. After launching, they were floated into position, built up and sunk at the same time. Before putting the cribs into position, however, the site had been dredged 18 in. to 2 ft. below the required grade of the seal. This was approximately 10 ft. below the old river bottom. A feature used in the sinking of the cribs was the use of concrete deposited in beams, the forms for which had been constructed as the crib was being built. These beams answered the purpose for weight very well and were a great deal cheaper than

C. P. R. Harrison River Bridge. View of cofferdam between caissons.



General elevation and plan, Harrison River Bridge.

the handling of a corresponding amount of rails or the erection of sand boxes for weighting.

Sealing and Pumping Cofferdams and Cribs

A concrete seal was placed in all cofferdams and open cribs excepting the East Abutment and Pier No. 11. The thickness of the seal depended on the head of water to be pumped and varied from 6 ft. in Pier No. 1 to 10 ft. in the crib for Pier No. 7. The concrete for the seal was mixed in 1:2:4 proportions and deposited through a tremie pipe with excellent results. The tremie was handled by a 5-ton triplex chain hoist and travelled across the cofferdam on an I-beam and trolley supported at either end by 10 in. x 10 in. posts. The latter was moved from end to end of the cofferdam on the top set of rangers. The seal was made in two layers.

The concrete in the seal was allowed to set three to seven days before starting to pump. There were no leaks whatever through the seal in any of the cofferdams and the pumping proved to be a simple proposition. Plenty of pumps were installed each time to pump out the water in the cofferdam rapidly, so that the leaks in the sides could be located and stopped. Generally after the first 24 hours a small Nye Pump kept the cofferdams dry.

Pneumatic Caisson Piers

Owing to the difference in the elevation of the rock in the length of the piers, and to the fact that there was very little material overlying the rock at the downstream end of these piers, open cofferdams could not be used satisfactorily. For the same reasons a pneumatic caisson the full size of the pier would have been difficult and was not required for the load coming on the pier. The scheme used was to sink a small caisson at each end of the pier and connect these with a heavily reinforced concrete slab 6 ft. thick and on this build the shaft of the pier. The caissons being small, approximately 16 ft. square, they were built of 12-in. x 12-in. dressed timber for the working chamber and the deck, 3-in. ceiling and 3-in. friction planks. Above the deck 10-in. x 10-in. rangers and posts with 3-in. planks made the cofferdam.

The usual pneumatic method used by The Foundation Company, Limited, was used here. Amply large compressor and lighting plants were installed on the east bank near the boiler plant. One Standard Company combination man-and-bucket lock was used for all six caissons. A hospital lock was set up in the "Sandhog" house to provide for any cases of caisson disease.

Beyond the sharp dip of the rock in all the caissons, no difficulties were encountered.

There was a maximum head of water 53 ft. in the deepest caisson, which was the north caisson of Pier No. 8, and a minimum of 23 ft. of water on the south caisson of No. 9. There was likewise a maximum of 28 ft. of material from the river bottom to bed-rock in Caisson North No. 8 and a minimum of only 3 ft. overlying the rock in the South caisson of Pier No. 9. These two conditions called for a maximum of 27½ lbs. of air on North 8 and a minimum of 7 lbs. on South No. 9.

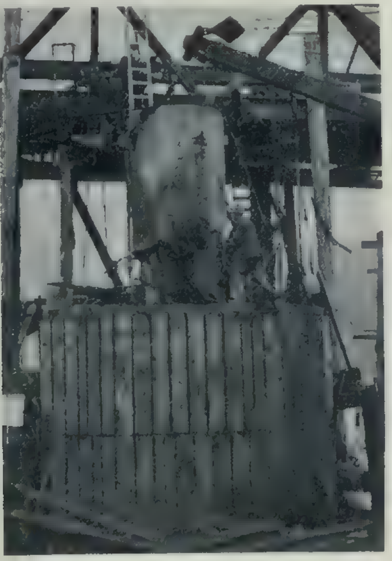
The air work was carried on very speedily considering the amount of work and the small size of crew that could be worked to advantage in the caissons. Air was on six weeks and an average of one caisson a week was made in sinking, which included time for changing the lock, changing the derricks, sealing and building up the caisson. One bucket lock was used for the entire job. The conditions of the bottoms required in each case some levelling off or benching of the rock.

Slab and Cofferdams for Piers Nos. 8, 9, and 10.

The method of constructing the slab between the two small pedestal piers, on which the shafts for Piers Nos. 8, 9 and 10 were to be built, was handled rather simply. A floor was made in shape and size to conform to the measurements of the area between the caissons at the point where the slab was to start. Two side panels were made to fit along and lapped by the cofferdams of the two caissons which had been left on with the scheme in view. Two I-beams were then placed on posts in caisson which had been carried up from the bottom, and the sides and bottom of the connecting cofferdams were then forced down to the required grade. Posts were put on cross ties in the floor and under the I-beams to hold the connecting cofferdam down, and it was also bolted to the sides of the caisson above the water. Eight sets of tie rods were put in, connecting the bottom or floor of the connecting cofferdam to the I-beam above. The rods carried the weight of the concrete slab put in after the cofferdam was pumped and the posts held the bottom down while the cofferdam was being pumped and until the concrete slab was in place. After the slab had set six or eight days, the I-beams were taken to the next pier. This gave the concrete time to develop strength enough to be self-supporting.

Mixer Plant

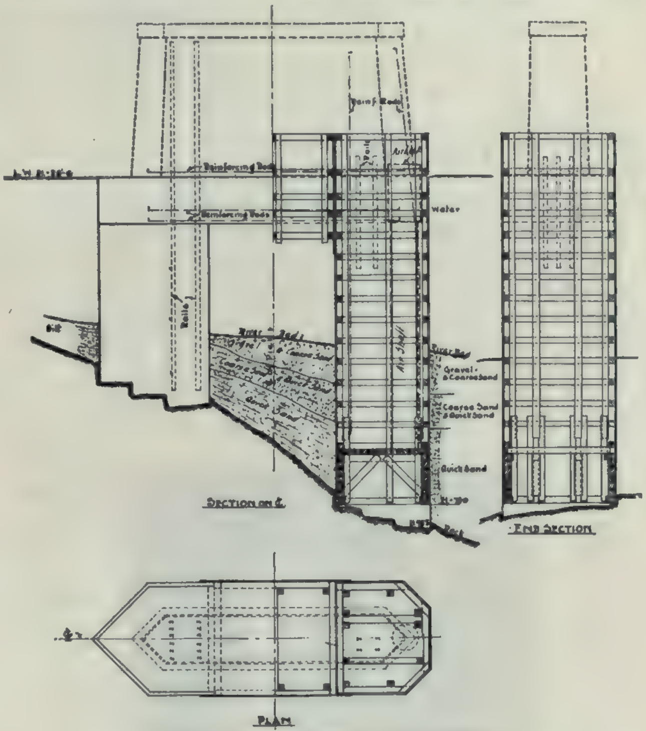
A floating concrete plant was used for all the concrete placed. The scow used was 22 ft. x 70 ft. x 5 ft. deep, with a 57-ft. tower; a one-yard Ransome Concrete mixer, steam driven; steam was supplied by a 48-in. x 96-in. upright boiler, a one-yard Insley concrete hoist, hopper, and 10 in. diameter chute suspended from the tower for spouting the concrete into the piers. A cement house on the back of the scow, 18 ft. x 20 ft., stored a day's supply of cement, which was filled either directly on to the scow from the cement house or transferred to it by another scow. One 1¼-in. Blakeslee jet furnished the water for the mixing plant, although a small feed pump was installed for emergency purposes. The engine used for the elevator was a 5 x 7 "O & S" Reversible Hoist and did exceedingly good work.



Air-lock on south caisson pier, No. 10.

The cement was received by cars and unloaded from a spur into a cement house which was raised to the elevation of the car floor. The cement was handled entirely by trucks from the car to the cement house and from the cement house to the scows.

The gravel used was run-of-bank gravel, dredged from Harrison River three and one-half miles above the work, and was as a whole in good proportions and made excellent concrete without any addition of sand, screening or washing. The gravel was received on scows and handled to the mixer hopper by means of a 16-in. belt conveyor. The conveyor was so attached ed that the outer end could be raised or lowered according to the height of the gravel scows. A niggerhead or spool was put on the outer end of the driveshaft and was used to handle the cement from the cement house on the scow to the mixer hopper. The cement was pulled up an inclined track in a small car in the amount needed for each batch. The sacks were untied in the house before being sent up and the empty sacks were sent down each time.



Typical caisson, Harrison River Bridge.

The gravel plant consisted of the following: 1 small stern-wheel river tug-boat; 1 small gravity swing derrick with 40 ft. boom, 20 ft. "A" Frame on 20 ft. x 60 ft. scow; 3 gravel cargo scows (two 22 ft. x 65 ft., one 24 ft. x 60.). A small crew handled the gravel problem, there being only the captain, one engineer, one deck hand, a foreman and one fireman on the dredge, making five all told.

The work was started in August, 1913, and completed on March 31st, 1914. The greater part of the time traffic was very heavy on account of the double-tracking on both sides of the bridge—earth and rock ballast trains besides the regular traffic.

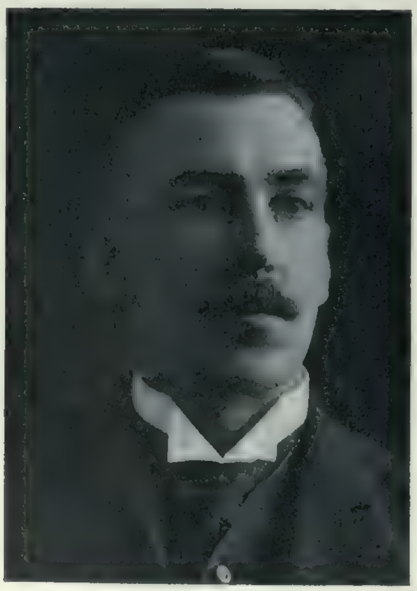
The work was done by The Foundation Company, Limited, for whom W. F. Collar was the Superintendent of Construction. H. Rindal was Division Engineer for the C. P. R., and E. B. Bail Resident Engineer.

Recent Developments in the Field of Municipal Engineering

By F. W. W. Doane, City Engineer of Halifax, N. S.

NO student of municipal engineering would hesitate to say that there are new municipal engineering matters coming along every year. The province of the municipal engineer is a wide one, and its limits are being extended every season.

Municipal engineering has been, in the past, confined principally to works of construction, but in recent years municipal development has created such a change in municipal engineering departments, that the engineer of to-day engaged in such work must not only be an engineer, but a lawyer and financier. Further, we have entered upon an age of administration with a new and larger conception of the possibilities of industrial leadership. The municipality is beginning to refuse to trust for its administration to processes of learning through experience. There is being created a central strategic position, to be occupied by the professional administrator who must be a master of the forthcoming science of administration. For such a position the municipal engineer is peculiarly fitted, both by education and experience.



Mr. F. W. W. Doane.

Let us hope that municipal engineering work will, in the future, be completely divorced from political influence, as it should have been long, long ago. While the office of City Manager is a new one, the idea and the principle involved, will go far as the system becomes better understood. While the man occupying the position of City Manager may not be a qualified municipal engineer, he will, nevertheless, be engaged in municipal work. The problem of discovering the right man for the place promises to be anything but easy. It has been said that a city engineer should have the wisdom of Solomon, the patience of Job, the executive ability of Napoleon, the diplomacy of Tallyrand, and the temper of an angel. That is an order of considerable dimensions, yet it is equalled by the requirements specified in a recent publication for the ideal city manager. He must be a man of most wonderful make-up, naturally humane, patient, tactful, polite, forceful, inspiring, fair, receptive, well educated, quick of perception and decision, and last—but not least—thoroughly trained in engineering and versed in law and finance. Surely it would be a mistake to discuss the salary that would attract such a man. I would suggest that any one finding such a man lying around loose should grapple him with hoops of steel.

I propose to review briefly some of the new matters in municipal engineering.

In roadways, new forms of construction are being tried out every year. A strong and persistent effort is being made to discover a cheap form of pavement or roadway construction which will enable the municipality of moderate means to maintain its roads in fair condition under the destructive traffic of motor vehicles. Many forms of construction have been tried out, but there is none that can be pronounced entirely satisfactory in our climate. Tar or asphaltic macadam has proved to be a better roadway than the old water-bound macadam, but its life is short. The older forms of pavement are too expensive. Rocmac has its admirers but also its opponents. Cement concrete has made great progress in the sympathy of municipal men, and if the tendency to crack can be overcome there is little doubt that it will be a very popular pavement, owing to the low cost in comparison with its permanency.

In this connection, reference should be made to the necessity for a heavier foundation under nearly all forms of pavement. This is being recognized by the most progressive municipal engineers. For instance, the usual construction of sheet asphalt pavement has included a six-inch concrete base. At times, the thickness was reduced to four inches on residence streets. Such thickness will not be found sufficient to carry the travel which is promised in the future, either in such streets or on some of our country highways. With the advent of the motor truck, the traction engine and the motor omnibus, municipal engineers are arriving at the conclusion that even nine inches of concrete will be necessary in some formations to furnish a satisfactory support. Such a thickness will be demanded eventually, because, within a radius of thirty miles of large cities where motor trucking is becoming common, loads amount frequently to ten tons. In the old country, concrete foundations are broken up not so much by ordinary motor vehicles as by those over 3½ tons in weight, shod with steel tires. One class of these is allowed to travel at eight miles and another at five miles an hour. In some places in England, the depth of the concrete foundation has been increased to ten inches.

While experience in this connection has been brief, there is a strong consensus of opinion among English municipal engineers that both foundation and wearing surface should be absolutely stable in character, and with both the concrete foundation and the wearing surface so constructed that they will not move under traffic. The selection of a pavement for hills is as difficult as ever, and can be settled only by an expert.

In water supply, the municipal engineer to-day is studying the problem of greater purification. A discussion of such work is beyond the scope of this article.

In sewerage, the method of disposal is the great problem, and especially the treatment of sludge. Progress is being made every year, and while some theories which promised well have fallen through, others have risen to take their place. There seems to be little doubt that the next ten years will do much to simplify the sewage disposal problem—especially in connection with the sludge.

In street cleaning, improved methods are being recommended. In a recent report on a proposed model street cleaning district in the borough of Manhattan, New York, J. T. Fetherston, Commissioner of Street Cleaning, points out the possibility of introducing many improvements and economies. The system now in use in New York is practically the same as that installed by the late Col. Geo. E. Waring over seventeen years ago. The main feature of the new plan, which is novel only in its adaptation to municipal conditions, replaces horse-drawn vehicles with power-driven motor vehicles, each fitted with three types of trailers—one for street flushing or sweeping, one for refuse collection, and the third for ploughing, sweeping and hauling snow. The remainder of the equipment will consist of a standard type of covered receptacle for holding garbage or ashes, and a transfer station or dump provided with power-operated devices for handling refuse. No other city has taken up the tractor-trailer system, but it is employed successfully by private companies.

While few municipalities may be in a position to spend the money on street cleaning that the city of New York can spend, representatives of those municipalities who are interested in street cleaning, should visit the city of Montreal, where the first motor-driven pick-up street sweeper to be used in Canada is in operation. Motor-driven street sprinklers are, of course, not new, but a new motor street sprinkler brought out by the Tiffin Wagon Company, of Tiffin, Ohio, is worth looking up. It is claimed for this new vehicle that it distributes the water more evenly on a street, that it covers practically twice the territory for each filling, and that it will cover three times the territory of the horse sprinkler in its working day. It would seem within the province of all municipalities to encourage the use of motor vehicles in every possible way, both in their own service and at large. The time is coming when such use will be more urgent.

Sanitation is demanding that the horse be dispensed with eventually on public thoroughfares. Further, because of the ability of the motor vehicle or its driver to navigate better through crowded traffic, congestion, which is a serious problem on all busy streets, is to an extent relieved.

The urban municipality of to-day is doing more and more of its own work and going more and more deeply into municipal ownership or control of public utilities. Civic asphalt plants are no longer rare; the private ownership of lighting plants and water systems is beginning to be the exception; the municipal ownership of street railways has passed the experimental stage; municipal coal yards are already in operation, and the public ownership of coal mines is more than a possibility of the future. Central heating plants have not been adopted by municipalities to any extent, but it is probable that they will be in the near future. As an illustration of the extent to which such work has gone, the central heating plant of the University of Wisconsin, Madison, Wis., may be cited. About 22,000 tons of coal is the annual consumption. Only 10 per cent. of the total fuel is chargeable to power uses. All power exhaust, together with low pressure live steam, is used for heating. At present 42 buildings are heated from the central plant. The distribution system includes two miles of tunnel and one mile of conduit. The maximum pipe size is 16 inches, and on this a total thickness of 3 inches of 85 per cent. magnesia insulation is used. The heating pressure is 5 to 10 pounds and no difficulty has been experienced in maintaining pressure at the receiving end.

The Minnesota Legislature recently gave the engineering and constructional organization of the City of Minneapolis a noteworthy endorsement by passing an Act which authorizes the City to acquire and maintain a union steam railway passenger terminal. Similar extensive powers are vested in the city for the purpose of a grade crossing elimination, for which the city may make complete plans. Efforts in the past to secure a union station in Minneapolis by private action had failed. In the grade crossing work, the cost must be borne by the railways. Even the damage to abutting property is included. One railway is engaged in such work already, but for future work the city will make plans. The City of Minneapolis also has a project for a number of municipal ice houses.

Halifax to the Fore in Town Planning

In town planning, many cities and towns of Canada are engaged in new municipal engineering work. The city of which the writer is the Engineer, has the honor of obtaining the first town planning legislation passed in Canada. It has been protecting residential property and carrying on other similar improvements since 1896.

A bureau of municipal research is one of the latest moves in municipal work. It is claimed that in the city of Cincinnati, a city of 600,000 inhabitants, a bureau of municipal research in two years saved $100,000 on a 5-year contract, $65,000, $17,000 and $168,000 annually, and the whole cost of a purchasing department, besides the discovery of 125 miles of unrecorded sewers. This question, with municipal publicity, is well worth the attention of every municipality.

A recent announcement is to the effect that the Dominion Government, through its Department of the Interior, is placing under reservation all vacant Dominion land that the Superintendent of Water Powers may recommend to be available for the development of water power. Six whole sections of land in Northern Alberta have recently been reserved until a complete survey of the famous power site at Vermilion, on the Peace River, can be made. Similar reservations have been made in the various provinces of Manitoba, Saskatchewan, Alberta, and in the railway belt of British Columbia. These include land contiguous to Grand Rapids on the Athabasca River, the various power sites on the Elbow and Bow Rivers in the Province of Alberta, Grand Rapids on the Saskatchewan River, and all unoccupied land along the Winnipeg River in the Province of Manitoba. It is stated that other reservations will be made from time to time upon the receipt of sufficient information to enable the Superintendent of Water Powers to make a definite recommendation covering a description of the land that might be required for power purposes.

In Nova Scotia, an important progressive step in municipal engineering during the past year was obtaining from the Provincial legislature a general law which provides that in future no private corporation which has authority to erect poles and wires on public streets, can do so without first obtaining permission from the municipality.

It has been mentioned that the municipal engineer of to-day must be a financier as well as an engineer. It may not be surprising, therefore, to find that in Nova Scotia a municipal engineer has suggested a mutual municipal insurance scheme. It has been criticized adversely by the financial journals, but in the opinion of the speaker it has come to stay. Although the author of the scheme was not aware of it, a somewhat similar scheme has been tried out in the old country, with a decided success. The insurance of municipal property only is a business of a non-hazardous nature. The English municipal mutual insurance body reduces premiums at once on municipal property and every five years thereafter. The association is eleven years old and during its existence it has paid all claims liberally and promptly, and reduced the premiums of its policy holders by $50,000. Notwithstanding this, and the low rates of premium charged, it has accumulated $95,000, all of which is solely the property of the municipal fire policy holders, who have increased in number from thirteen in 1903 to over 450 in 1913. The Association's average of net loss for fire during its ten years' work was only 10.7 per cent. of its net premium income, whereas the loss ratio of the average insurance company was 55 per cent. It is quite obvious, therefore, that when a local authority insures with an ordinary company the public are simply paying for the losses incurred by the company in general and foreign business.

Design and Construction of the Bassano Dam[*]

By H. B. Muckleston[†]

THE Canadian Pacific Railway Company has recently completed, as a part of its great irrigation project, one of the most notable overfall dams now in existence. The dam, which is located on the Bow River, about one hundred miles southeast of Calgary, is noteworthy not only because of its dimensions and the composite character of its construction, but also because of the unusually great depth of water which it is designed to pass over its crest during floods.

The Irrigation Project

Much of the greater part of the irrigated area is on the North or Red Deer River slope of the divide; consequently only a fraction of the water diverted will ever return to the Bow River. The total irrigable area commanded by the system is, in round figures, some 440,000 acres. The canal system, to reclaim this large area, involved moving some 21,000,000 cu. yds. of excavation in all classes; over 100,000 cu. yds. of concrete were built into the structures on the main, branch and secondary canals; and 9,500,000 ft. b.m. of timber were used in flumes, bridges and the structures on the smaller ditches and laterals. The total mileage of canals and ditches is in excess of 3,000. It will be seen, therefore, that the project is exceeded in magnitude by few outside India and by none on this Continent.

The first surveys for this project were made by the writer in 1906. They were confined to securing general information and to making rough estimates of the area which could be irrigated and the cost of the diversion works, based on several assumptions as to crest elevation of the proposed dam. These surveys showed that the project was feasible from an engineering point of view and that it could be built within the limit which had been set as to cost. Further surveys were made in 1909, and the crest elevation finally fixed after several alternative preliminary locations of the larger canals and a closer examination of the areas which they commanded.

Design of the Dam

At the point of diversion the main divide between the rivers is very close to the Bow; only 600 ft. away, in fact. At this point begins a wide valley known as Crawling Valley, which cuts square across the country from the Bow River to the Red Deer. Toward the Red Deer River it falls about 65 ft. in 13,000 ft. in the upper region, while toward the Bow the fall is 90 ft. in 600 ft. The average depth of this valley is about 70 ft., and its width about 600 ft. As the summit of the pass thus found was but 90 ft. above the river it offered a splendid opportunity to divert water for irrigation, provided it proved feasible to construct a dam of some height across the river valley.

Fig. 1 is a general site plan showing the location of the dam. The left bank of the river, which forms the outside of the horseshoe, is a high clay cut bank or cliff, varying from 150 to 200 ft. in height, with practically no beach whatever at the bottom except in very extreme low water. The right bank or inside of the horseshoe is a gravel beach gradually sloping up to a silt bank at high-water mark. The tongue of land inside the horseshoe slopes gradually up from the toe of the shoe to the general bench elevation of the adjoining country. It shows visible evidence that it has been built by the river, as the stream gradually cut is way down and widened the sweep of the curve.

Fig. 2 is a general profile showing the result of the borings put down to determine the character of the foundations. Under the clay at a varying depth is a stratum of unknown thickness composed of a coarse water-bearing sand, not quite free running but weakly cemented. Most of the boreholes were stopped when the sand stratum was reached, but a few were carried deeper in an effort to reach the bottom of the sand, though without any success. It was found that the water in the sand was under a slight pressure, which was measured and found to correspond roughly with the fall in the surface of the river in a distance of about 3,000 ft. This was thought to indicate that the

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[*] This article is a condensed and re-arranged version of an article published in two parts by the Engineering News. We are indebted to our contemporary for the line cuts. The half-tone illustrations are from an article published in the Contract Record of December 17, 1913. The reader may be interested in referring to a complete description of the C. P. R. irrigation projects contributed to our issue of April 24, 1912, by Mr. A. S. Dawson, Chief Engineer, Canadian Pacific Railway, Department of Natural Resources.

[†] Assistant Chief Engineer, Department of Natural Resources, Canadian Pacific Railway, Calgary.

Panoramic view of the Great Bassano Dam.

overlying clay pinched out somewhere upstream, and three boreholes were put down to ascertain if this was so. It was found that at 2,600 ft. upstream from the site the clay was only 2 ft. thick. The theory that the water found access from the river was confirmed by subsequent observations on the pressure head in the sand compared with parallel readings of a gage rod in the river. The similarity of the curve was unmistakable, though there was a lag in phase amounting to 30 hr., for which no satisfactory explanation has yet been offered.

The strata under the tongue of land inside the horseshoe are similar to those under the river except that the gravel layer is very much thicker and is overlaid by a stratum of silt left behind by the river as it gradually cut its way down.

When the dam was first proposed, very little was known of the hydrology of the river, the few discharge records that were available being unsatisfactory in that they gave little or no indication as to the maximum floods which might be expected. The only refuge, therefore, was a careful series of gagings and a search for flood marks. From these gagings and what flood marks could be found it was estimated that a flood of 100,000 sec. ft. was possible, and the dam was designed to pass this quantity with 14 ft. of water on the crest. This corresponds to a runoff of 12.5 cu. ft. per sec. per sq. mile from a drainage area of 8,000 sq. miles.

The range in discharge of the river is very wide, varying as it does from a minimum in winter of about 1,200 sec. ft. to the calculated flood discharge above given. Ordinary spring and summer freshets seldom rise much above 30,000 sec. ft., though considerably larger floods of short duration are not infrequent.

The time factor in flood rises in the Bow is important, variations of 20,000 sec. ft. in discharge in 10 or 12 hours being by no means unusual and often coming without much warning. Owing to the narrow valley and steep slope of the river bed the pondage area above the dam is comparatively small, not over 3,500 acres, during low stages. It was therefore very necessary that means be provided for rapid working of any crest sluices, and also that the earth dam be given an unusual freeboard above ordinary pool level.

The dam as finally built consists of two or rather three parts: (1) an earth embankment 7,000 ft. long, built on the right bank inside the horseshoe; (2) a reinforced concrete spillway section, built in the river bed; and (3) a reinforced concrete canal headwork built at right angles to the spillway and integral with it.

The embankment varies in height from 35 ft. to zero. It was designed to have a top width of 24 ft., with 4 to 1 wet slope and 3 to 1 dry slope, and to have a freeboard at ordinary high stages of 9 ft. The thickness as built is much in excess of what the above dimensions would indicate, as a large surplus of material from the canal cut was wasted over the back of the earth dam, resulting in a top width varying from 40 to 100 ft. The wet slope is protected from erosion by a concrete paving surmounted by a curved parapet wall to prevent any wave wash from going over.

The spillway is 720 ft. between abutments. It is of typical Ambursen section (Fig. 3). The crest is divided into 24 openings, each 27 ft. long, closed when required by Stoney sluices 11 ft. high. The head-

Constructional detail of dam.

Sluice gates.

works consist of 5 openings, each 20 ft. wide, closed by Stoney sluices 14 ft. in height.

The general design of the composite structure was determined by the Railway Company's engineers after a careful study of all the conditions above outlined. Having decided that the cellular type of reinforced concrete construction would best meet requirements for the spillway and headworks, the detailed design of these parts was placed in the hands of the Ambursen Company, who also undertook the superintendence of construction. All drawings were approved by the Railway Company's engineers before becoming effective. Both design and construction were carried out under very complete specifications approved by both the Railway Company and the Ambursen Company.

The maximum alowable unit stresses used in the design of all parts of the structure were as follows:

Bearing power of foundations	2.5 tons per sq. ft.
Buttresses in compression	300 lb. per sq. in.
Buttresses in direct shear	100 lb. per sq. in.
Footings, compression in bending ...	500 lb. per sq. in.
Footings, tension in bending	0 lb. per sq. in.
Footings, shear in bending	75 lb. per sq. in.
Deck apron, compression in bending ..	600 lb. per sq. in.
Deck apron, tension in bending	0 lb. per sq. in.
Deck apron, shear in bending	60 lb. per sq. in.
Steel reinforcement, tension	14,000 lb. per sq. in.
Structural steel, tension	16,000 lb. per sq. in.

All the above maximum unit stresses are considered as limiting values based on loading of structures due to the greatest expected flood head, namely, 14 ft. above crest and on allowance made for effect of backwater.

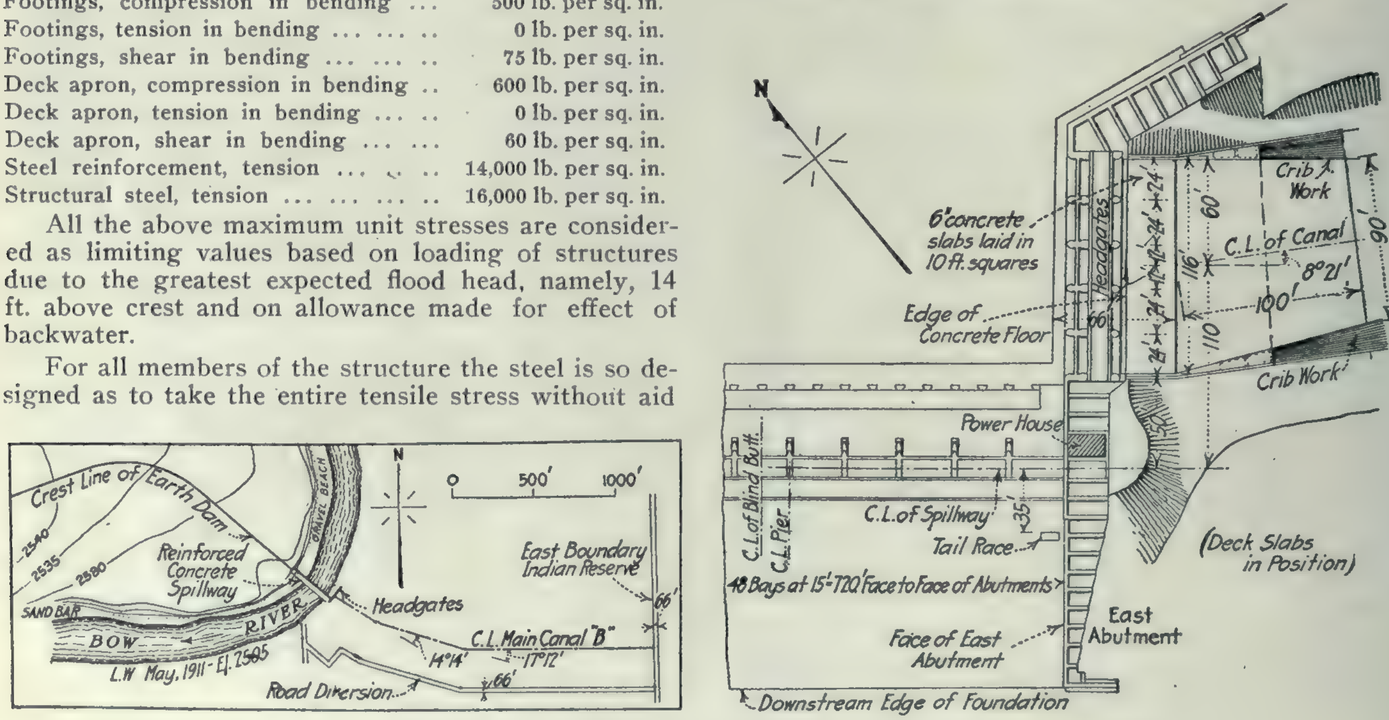

Fig. 1—General plan of Bassano Dam and detail plan of headgates.

For all members of the structure the steel is so designed as to take the entire tensile stress without aid from the concrete. For all buttresses, walls, tumbling hearth, etc., steel is inserted in such quantities as will assure against excessive cracking due to temperature stresses and vibration.

All cement was tested on the works and had to conform to the specifications of the Canadian Society of Civil Engineers.

One of the first problems to be solved was the spacing of the interior buttresses. This is a problem which depends on judgment and experience rather than on mathematics for its solution. After a number of preliminary designs had been worked up and studied, it was decided to space these buttresses 15 t.c. to c. and to carry the alternate buttresses up to form piers for the support of the sluice gates.

The floor of the structure is pierced by numerous weep holes to relieve any possible upward pressure from water which might pass the sheet piling and be trapped under the floor.

As mentioned above, the water contained in the sand stratum is under pressure, and strong presumptive evidence existed that this pressure was equivalent to the head of a point about 3,000 ft. upstream. If the presumption were true the upward pressure on the clay might, under certain circumstances, be more than the superincumbent weight, and accordingly steps were taken to relieve it. This was accomplished by twenty-four 5½-in. iron-cased wells bored through the clay and extended above the interior bridge level.

Stoney Gates—For the sluice gates, a great many different types were considered, the choice finally narrowing down to Taintor sectors as against the Stoney free-rolling pattern. The latter were finally decided on, for, while the choice involved a considerable increase in cost, it was felt that they would be better suited to the conditions and more certain in operation. The gates are handled from an overbridge and are counter weighted to 90 per cent. of their unimmersed weight. The overbridge is calculated for a loading equivalent to five tons on two pairs of wheels.

Floating Apron—In order to minimize the effects of any possible scour which may develop below the concrete apron, a floating timber apron has been provided (Fig. 3). This device has been found extremely effective in other situations in preventing scour in soft bottoms or, to put it more correctly, in transferring the scour to a point where it can do no harm. Since the floating apron is not closely built, it is not pressed down flat but assumes some mean position under the combined force of its own tendency to float and the tendency of the current to force it down.

Protection of Sluice Gates Against Frost by Housing and Electric Heating—One of the problems in the design of the dam to which a great deal of study was given was the effect of the peculiar winter climate on the structure and its operation. One of the salient features of the irrigation project is the large interior reservoir lying south of Brooks. It is intended to fill this reservoir during the winter months when the canals are not required for irrigation purposes. This involves very delicate control of the discharge of the

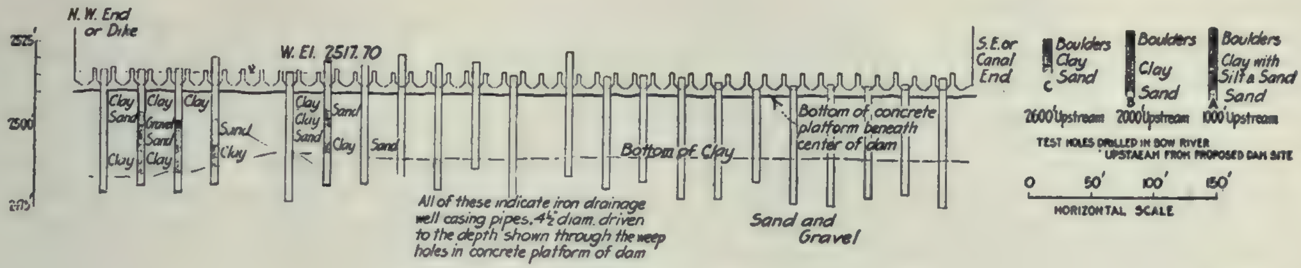
N. W. End or Dike
W. El. 2517.70
S.E. or Canal End
Clay Sand
Clay Gravel Sand Clay
Sand Clay
Bottom of Clay
Bottom of concrete platform beneath center of dam
All of these indicate iron drainage well casing pipes 4½ diam. driven to the depth shown through the weep holes in concrete platform of dam
Sand and Gravel
Boulders Clay Sand
2600' Upstream
2000' Upstream
1000' Upstream
Clay with Silt & Sand
TEST HOLES DRILLED IN BOW RIVER UPSTREAM FROM PROPOSED DAM SITE
HORIZONTAL SCALE
0 50' 100' 150'

Fig. 2

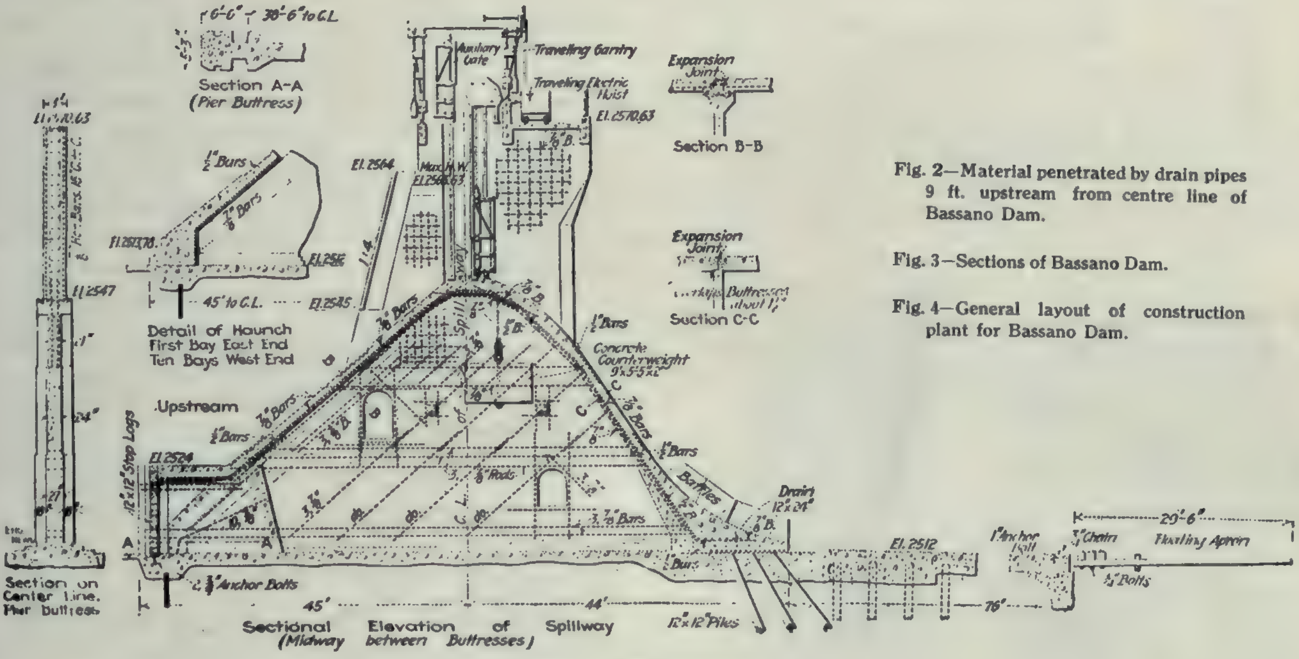

Fig. 3

Fig. 2—Material penetrated by drain pipes 9 ft. upstream from centre line of Bassano Dam.

Fig. 3—Sections of Bassano Dam.

Fig. 4—General layout of construction plant for Bassano Dam.

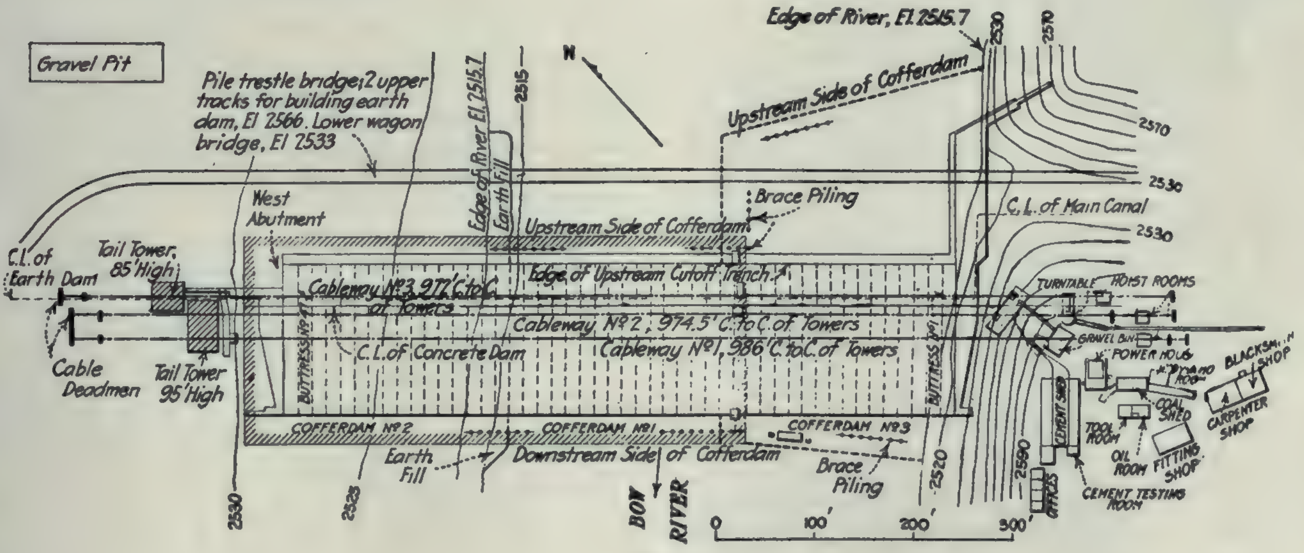

Fig. 4

Design and Construction of the Bassano Dam

canals in order to avoid trouble from ice jams and consequent possible breaching of the canal banks. It will be seen, therefore, that under no circumstances must the crest sluices ever be allowed to become inoperative through frost. To guard against this a very complete system of electric heating for the gates has been installed and special precautions in the way of housing have been taken to insure that all the canal head sluices and two of the crest sluices shall be free from ice at all times.

The effects of ice shove or expansion on the static stability of the dam were very carefully considered and allowed for. It was felt, however, that even so it would be wise to treat the cause rather than the effects, and steps are therefore taken to keep a trench open close above the piers.

Layout of Plant

Construction was commenced in October, 1910, with the erection of the plant and building of Cofferdam No. 1. Fig. 4 shows the general layout of the construction plant. Three cableways with spans of 975 ft. were erected, requiring tail towers 95 to 85 ft. in height on the west shore, and head towers from 47 to 55 ft. high on the east shore. The two upstream cableways, which were used for handling forms and concrete, each had a carrying capacity of three tons, whereas the downstream cableway, used exclusively for gravel, had a capacity of five tons.

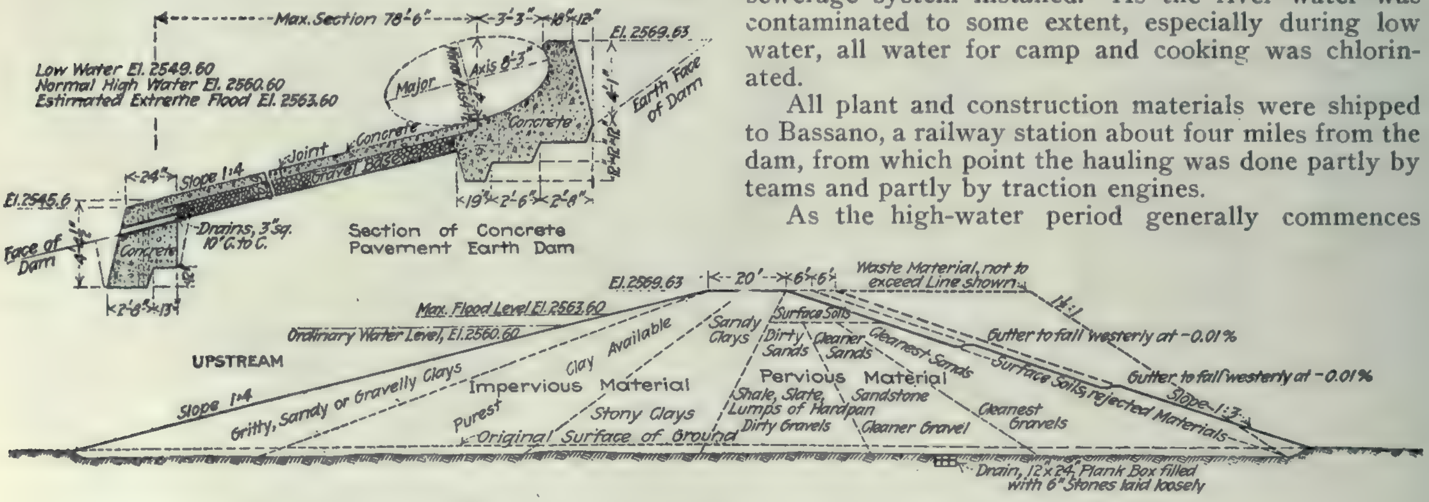
Max. Section 78'-6"
3'-3"
18"
12"
El. 2569.63
Low Water El. 2549.60
Normal High Water El. 2560.60
Estimated Extreme Flood El. 2563.60
Major
Axis 8'-3"
Concrete
Earth Face of Dam
Joint
Concrete
Gravel Base
24"
Slope 1:4
El. 2545.6
Face of Dam
Concrete
Drains, 3"sq. 10' C. to C.
19"
2'-6"
2'-8"
2'-8"
13"
Section of Concrete Pavement Earth Dam
El. 2569.63
20'
6"
6"
Waste Material, not to exceed Line shown
1½:1
Max. Flood Level El. 2563.60
Ordinary Water Level, El. 2560.60
UPSTREAM
Slope 1:4
Gritty, Sandy or Gravelly Clays
Purest
Clay
Available
Impervious Material
Stony Clays
Original Surface of Ground
Sandy Clays
Surface Soils
Dirty Sands
Cleaner Sands
Cleanest Sands
Pervious Material
Shale, Slate, Lumps of Hardpan
Sandstone
Dirty Gravels
Cleaner Gravel
Cleanest Gravels
Surface Soils, rejected Materials
Gutter to fall westerly at -0.01%
Gutter to fall westerly at -0.01%
Slope 1:3
Drain, 12"x24" Plank Box filled with 6" Stones laid loosely

Fig. 5—Earth embankment, Bassano Dam showing disposition of materials and detail of concrete pavement.

Gravel—A gravel pit, located about 500 ft. west of the west abutment and on the upstream side of the earth dam, was opened up, requiring about 16 ft. of stripping. The gravel was found to be naturally well graded, very clean, and containing about 10 per cent. excess of sand. The stripping and excavation was done during the night, and in the daytime the gravel was excavated and conveyed in dump wagons to a trap located under the gravel cable. From here, it was shot into a 2-yd. bucket, which was picked up by the cableway and carried to the 200-yd. gravel bin on the east shore. Two 18-in. steel pipes with sliding controlling gates conveyed the gravel from the bin to two measuring hoppers located above the two 1-yd. Smith mixers.

Cement and Concrete Handling—The cement, which was stored in a cement shed with a capacity of 800 bbls., was by means of an overhead conveyor carried to a hopper whence it was shot down through a 12-in. pipe into a bin placed between the two mixers. The bin was equipped with two spouts in which were fixed measuring slides for the different mixtures, and the cement was in this way distributed to the measuring hoppers which contained the gravel. The whole of the dry mixture was then by a tripping device dumped into the mixers. The two upstream cableways, located directly above the mixers, picked up the concrete buckets, which were of the controllable bottom-dump type, and carried them to wherever concreting was under way. Here the concrete was transferred to a controllable bottom-dump car, which travelled on sectional track resting on the forms. The maximum output of this concreting plant was 350 cu. yds. per 10-hour day.

Owing to the considerable size of the construction plant, well appointed repair shops were installed so that delays might be avoided and repairs and general maintenance carried out in an efficient manner.

The size of crew engaged varied considerably from time to time, the maximum number being about 250. The unskilled labor was principally Italian, the skilled labor being of all nationalities. Suitable bunk houses and dining rooms for each class, electrically lighted and steam heated, were built, and a waterworks and sewerage system installed. As the river water was contaminated to some extent, especially during low water, all water for camp and cooking was chlorinated.

All plant and construction materials were shipped to Bassano, a railway station about four miles from the dam, from which point the hauling was done partly by teams and partly by traction engines.

As the high-water period generally commences about the middle of May and lasts well into August, it was necessary to have each section so far advanced in construction before that time that work could be continued even if the coffer-dams were flooded. The general construction programme was therefore arranged accordingly.

Coffer-Dams—The first coffer-dam constructed took in the central third of the structure, and the river was passed through the easterly third. Upon completion of the central third to a level above high water, the coffer-dam was removed and the river passed through between the buttresses. The westerly third was then started, upon completion of which the easterly third was commenced, with the river passing through the central and westerly section, the design of the type of structure lending itself admirably to such a procedure. The coffer-dams consisted of two rows of piles 12 ft. apart, the piles in each row being 8 ft. c. to c. The outside row carried wailings supporting 3-in. tongued-and-grooved sheet piling, which was driven with a steam hammer, the back row acting as brace piling. As the river is fairly shallow at the dam site, the greatest depth at low water being only 8 ft., no particular trouble was experienced in the construction of the coffer-dams.

Forms—All forms used were sectional. One departure however, was that of removing one entire group of forms together by means of the cableways and reerecting them without taking them apart.

Excavation—Most of the excavating was done by teams, wagons and slip scrapers. As the work was continued all the year round, special arrangements had to be made for thawing out the ground. At the end of the day tarpaulins 100 x 150 ft. were supported by means of horses over the excavation and numerous salamanders placed underneath and kept stoked overnight. In the morning the canvas and the salamanders were removed and work continued. In this way it was possible to gradually thaw the frost out of the ground, although in places it was frozen 6 ft. deep.

Progress—Concrete was first poured in Floor Bay No. 17 on March 22, 1911, and continued without interruption practically until November, 1912, when the bulk of the concrete had been placed.

During the time no stops were made except when the thermometer fell below —15 deg. F., when concreting was suspended until the weather got milder. Special provisions were made when the plant was erected for heating the water and gravel, and as all the forms were double boarded no difficulty was experienced in keeping the concrete from freezing. In fact, it was noted on many occasions that the concrete would still be steaming hot when the forms were removed about four days after the concrete was placed. Construction was resumed in April, 1913, and completed in May, 1914, during which period the canal walls and the housings over the headgates and power house were completed. In November, 1913, the temporary closure of the dam was made with 12 x 12-in. stop logs, followed immediately with the permanent concrete closures, the driving of the piling under the lower part of the ogee curve and the concreting of same.

The piles, which were 12 x 12-in. square timbers shod with cast iron points, were driven to an average depth of 25 ft., with two 1½-ton steam hammers, in inclined leads. This work was done inside a cofferdam built on the concrete carpet and the river taken care of by means of the two 6-ft. under sluices in the middle of the structure. The gravel fill inside the dam was pulled by trains running on the bridge deck and loaded by a steam shovel located at a gravel pit at the west end of the earth dam. The gravel was dumped into hoppers and conveyed to the interior of the dam by means of spouts passing through holes cut in the crest.

Sluices—The Stoney sluices and all their machinery for both the dam and the headworks were manufactured by Ransomes & Rapier, Limited, of London, England. They are of the usual type, working on free rollers and stanched by a rubber-covered round rod hung in the angle between the pier and the skin of the gate. Each sluice is provided with means for hoisting by hand. Power operation for the crest sluices is provided for by four movable trolleys on the bridge, arranged to engage any one of the operating shafts. In the case of the canal head sluices a separate motor is provided for each gate. In order to prevent any possible damage from over-winding, each gate is equipped with a limit switch which breaks all electrical connections when the gates approach within 3 ins. of the full travel at either end.

The design for the gates and operating mechanism was worked up by the manufacturers under specifications drawn up by the engineers of the Railway Company. The gate, guides and machinery were shipped in the knockdown, and erected by the Railway Company under the supervision of an expert erector sent out from England. So well had the work of manufacture been done that the various parts went together with little or no subsequent alterations or fitting.

Auxiliary Gate—As an emergency closure in case of accident to the main crest sluices, a special auxiliary gate is provided. This gate is similar to the permanent gates except that the position in the guides is reversed so that the skin is on the downstream face of the girders instead of the upstream face, and that an endless chain of live rollers working on the gate is provided instead of the rigid roller trains provided for the main sluices.

The auxiliary gate is handled by a gantry crane running on rails on the bridge girders. As the gate will be used but seldom, no provision is made for counterweights or power operation.

Power Plant—As stated above, the time factor in flood rises is so small that special provision was necessary to insure very rapid operation of the crest and canal sluices. To provide electric power for this work, a small power plant was built in a chamber provided for the purpose in the east abutment. The plant consists of a 180 h.p. reaction turbine, with Woodward governor, connected by belt to a 100 kv.a., three-phase, 60-cycle, 2,400 volt generator. The plant is equipped with step-down transformers furnishing current at 110-220 volts for the operation of the motors and for a complete lighting system in the dam and about the headworks.

Looking across the Bassano Dam.

Earth Embankment—The earth embankment (Fig. 5) was built of selected material from the canal cut. The specifications provided for the most approved methods of construction by spreading and rolling the materials in thin layers and for sprinkling if found necessary. The rear half of the dam is underdrained in order to steepen the plane of saturation, and to intercept any possible flow along the surface between the dam proper and its foundations. Before commencing construction, the foundation surface was carefully stripped of surface soil and thoroughly plowed to give a good bond.

The contractor for the earth portion commenced work by building a double-track narrow-gage trestle across the river. On the right bank, this trestle was continued as two single-track trestles about 100 ft. apart. The material was loaded into dump cars and hauled by locomotive to the dam, where it was dumped from the trestles and spread by four-horse Fresno scrapers. The continual trampling by four horses abreast, and the thin spreading which this method resulted in, gave such a thoroughly dense bank that the clause of the specifications relating to rolling was not exacted.

At the connections with the spillway the earth was very carefully spread and compacted. A good proportion of this work was done by sluicing in material by means of a jet of water under pressure. The material available was not very well suited to the process, being an unusually pure blue clay, and the result has not been entirely satisfactory owing to the very long time required for the backfill to drain.

Personnel—The preliminary designs for this dam and the surveys for the project of which it is such an important part were made by the writer. The detailed designs for the spillway and headgates were made by the Ambursen Hydraulic Construction Company.

H. Sidenius was resident engineer for construction of the concrete work, and has assisted in the preparation of this article. A. J. Raymond was Superintendent of Construction. A. Frohoefer, Division Engineer, was in charge of construction of the earth embankment and paving, and the excavation of the canal.

The work as a whole was under the direction of A. S. Dawson, Chief Engineer of the Department of Natural Resources, Canadian Pacific Railway Company, Calgary, Alberta.

Reinforced concrete roof tiles have been placed on a number of buildings constructed in connection with the Catskill Aqueduct, according to the 1913 report of the Board of Water Supply of New York City. The tiles were made of 1:2 mortar reinforced with 1½ x 3-in. wire mesh. All tiles except the hip tiles were made with the weather surface up, shaped and surfaced with a special steel screen. The hip tiles were cast in sand molds. Under test the flat tiles showed an ultimate strength of 30 lbs. per inch of width when centrally loaded on a 35-in. span, and were impervious under a 3-in. head of water when twenty-eight days old. In place, they also stood well under rains and snows, showing no leakage at any time. From the satisfactory results of this experiment it was determined to use concrete tiles to roof all aqueduct superstructures.

The city of Alexandria, in Egypt, is setting an example in proceeding with municipal enterprise in the face of the depression brought about by the European conflict. The municipality is asking for tenders until December 8th for the installation of a drainage system comprising the construction of a general system of sewers, the erection of a pumping station and the building of a main outfall into the sea. We note that plans may be obtained upon the deposit of 40 piasters ($2.00).

Water-bound macadam is being used in the Panama-Pacific Exposition for most of the streets and driveways, the total wearing surface of which is about 444,000 sq. yds.

Interesting Process of Manufacturing Steel Pipe

EXTENSIVE additions are being made to the waterworks system at Bombay, India. The work is interesting as it marks the first occasion upon which huge steel pipes of the lock-bar type have been made in that country. The contracts awarded to date total two and one-quarter millions. The total length of the new main will be about thirty-three miles. Half the length of the main will consist of steel pipes which are being manufactured on the scene of the work.

The manufacture of the steel pipes is carried out in the city of Bombay through an interesting process. The pipes are made in 28-foot lengths or over twice as long as the pipes of which the present main is constructed, and are 50 inches internal diameter.

To follow one of the large steel sheets, which measure 28 feet long and 6 feet 7 inches wide, through the works will illustrate the process of manufacture. The sheet is first lifted from the stack by a hydraulic crane and then passed through a set of rollers to take out any bends or buckles which it may have received in transit. After having been straightened it is passed on to a very large and powerful planing and upsetting machine. The next stage is to bend this 28-foot long sheet to a half circle, and for this purpose a set of rollers specially designed to take this long length of plate are used. The next operation is to join two of these long half circular trough-like sheets together to form a pipe, and this is where the lock-bar joint is used.

The next operation is to close down the lock bars over the thickened edge of the plate, and this is done with a powerful hydraulic press. This press is arranged to close both bars at once, and this result is obtained by having a mandril which supports the pipe inside while a ram comes up from the bottom and squeezes the bars home in the tools or dies shaped specially for this purpose, the top die being supported by the casting of the press. The force exerted by this press is 450 tons at each stroke. The dies are about a foot long, and a few inches only are done at a time, the pipe being moved through the machine till it is completed. The next operation consists of trimming the ends of the pipes, the bars and the sheets not being supplied exactly to length nor exactly square. This is accomplished with a couple of hydraulic shearing machines. The pipe is then ready to be tested before receiving its protective coating. Each pipe is filled with water and tested to 200 pounds per square inch It is then rolled to and dipped into a steel tank, which is full of a mixture of tar and Trinidad asphaltum, which is kept at a temperature of 350 deg. F. by furnaces which are arranged under it. The pipe is allowed to remain in this bath until it reaches the same temperature as the bath itself, and it is then hauled out and lowered into a revolving frame. While in this frame a strip of hessian cloth is laid on the pipe while it is revolving, the result being that the hessian is wound up on the pipe spirally from end to end.

The next operation is to spread more of the mixture from the tar bath on top of this hessian, thus thoroughly saturating it. A coating of sand is then thrown on the pipe, and while the pipe is cooling any roughness in the coating is smoothed down by the use of hand rollers. When cooled sufficiently for the coating to harden the pipe is rolled away ready to be taken away to be laid and jointed.

Refuse Destruction—The Evolution of Efficient and Economical Methods of Disposal

Contributed by R. O. Wynne-Roberts, Regina.

ONE of the primary duties of a municipal authority is to dispose of the waste products of a city, quickly, hygienically and economically. Sometimes, however, such a duty is a somewhat difficult one to carry out. The satisfactory disposal of sewage, for example, has engaged the attention of specialists for many years, and it must be acknowledged that in a great number of places the efforts to treat sewage efficiently have been more or less failures, for a satisfactory effluent is to be found in only a few places. Yet a solution must and will be found for this problem, and meanwhile communities have perforce to adopt the best available process.

In the matter of refuse disposal the situation is somewhat dissimilar, for a large number of towns have surmounted the difficulties with good results.

The temptation is to dispose of the refuse by the easiest way, even if it is not the most sanitary means. Refuse tips are plentiful, but the modern tendency is to abolish such dumping grounds as are used without discrimination, and adopt some other method. It is somewhat late in the day of advanced sanitation for filth to be deposited on the outskirts of a city without care or consideration and thereby be an annoyance to the people who are dwelling in the neighborhood, if not create a menace to the public health.

Town refuse consists of such a heterogeneous mixture that it varies in every load, every day, and in every place. In cooler climes there is a large proportion of ashes, whilst in warmer latitudes vegetables and other refuse will be more pronounced. Refuse from towns in districts of high rainfall and humidity will probably be more moist and resistant to fire than in districts of low rainfall and humidity, in spite of the receptacles being usually covered.

The quantity of refuse produced per capita in Europe is less than in America and as a rule no division is made for the purpose of collection.

In America, town refuse is often divided into three main classes—garbage, which "consists of organic waste or residue of animal, fruit or vegetable matter, and any matter or substance used in the preparation, cooking, dealing or storage of meat, fowls, fruit or vegetables"; ashes, which "constitute waste due to the combustion of coal or other combustible material from residences, manufactories or business places and consist of fine ash, clinker and unburned coal"; rubbish, which consists of discarded and useless waste matters from residences or places of business not classified as garbage or ashes, such as paper, straw, excelsior, rags, bottles, old clothes, shoes, tin cans and other like waste materials."[1] There are other refuse such as manure, street sweepings, dead animals, night soil, sludge, etc.

In America the collection of town refuse is often made separately for each class named. Separate receptacles have to be provided and the contractors or the municipal authority make periodical calls to remove each class of refuse. Much depends upon the frequency of such collections, as to the cost of the work and the efficacy of this system. Daily removal by municipal forces will obviate practically all nuisance, and if rightly organized a combined collection can be as economically done, if not more so, than insisting on the wrapping of garbage in paper and the separate collection at less frequent intervals. It can be easily understood that the separation of garbage, ashes and rubbish entails the loyal support of the householders and the ordinary experience is that the simpler the duties imposed upon the householder and others, the more likely they are to be performed.

The common method of refuse disposal is by dumping it into depressions or pits or on waste land. Reference has already been made to this and it is therefore necessary only to state that progressive authorities are becoming more insistent that such a method is not desirable in well governed cities, unless due care is taken to cover the refuse with earth or other deodorant.

Mr. R. O. Wynne-Roberts.

The disposal of garbage on pig farms is repugnant to the minds of all citizens having a high regard for the welfare of the people, and for the production of food by clean methods. It is stated that about 75 pigs are necessary to dispose of one ton of garbage daily.[2]

In Los Angeles, Cal., the garbage piggery was investigated by the Grand Jury. They reported that "the investigation of this Grand Jury shows that at the present time (March, 1912) there are located on the hog-ranch about 21,000 head of hogs; that the percentage of death of the hogs ranges from 40 to 65. We find further that the percentage of tubercular hogs on this ranch ranges from 10 to 20. Of this number two per cent. are condemned by the health officials, the other portion being placed on the market. We further find that cholera, strike, swine plague or swine fever is prevalent at the ranch at all times. In fact we find that at the present time this hog-ranch is quaran-

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NOTE—Small figures placed at the upper right-hand position of a letter appear frequently throughout this article. They are the author's references to sources of information. The details are given collectively on page 1173.

tined for all purposes except for the purpose of slaughtering for food.'"[2]

It is palpably unnecessary to add to the foregoing indictment. The writer is unaware if this practice prevails in Canada.

It may be stated that a contractor has recently been awarded the contract for the disposal of the garbage of Los Angeles by means of a garbage reduction plant. The city is to receive 51 cents per ton for the garbage.[3]

Two cities in the United States own garbage reduction plants, namely, Columbus and Cleveland, Ohio. There are other cities where contractors have erected reduction plants to deal with the garbage of these cities.

This method was first introduced in Germany (where, curiously, it is not much used today), and later on, it was introduced into the United States. It is similar to the plants installed in packing houses to dispose of the offal and to convert it into saleable by-products. Some of the reduction plants are operated on the "drying method," but the "cooking method" is stated to be the most satisfactory. The process consists of placing the garbage in steel digestor tanks, and when about 10 tons are so disposed of, the valves are closed and steam is admitted. After a few hours' cooking, the mixture is pressed to extract the free grease and the moisture. The solid matter is then dried and afterwards saturated with naphtha, gasoline or other solvents to dissolve the remaining grease. The solvent is recovered by distillation and the grease and tankage are sold to buyers, who refine the grease for various purposes, and the tankage is used for fertilizers.

Columbus is a city of about 185,000 inhabitants and the reduction plant has cost about $220,000. The sale of the grease and tankage brings more revenue than is sufficient to pay the cost of operation, plus the capital charges, as will be seen below.

Financial statement for 1913

1,095,594 lbs. of grease sold	$40,839.35
2,095 tons of tankage sold	14,223.31
Hides	1,247.39
Miscellaneous	489.73
Total receipts	$56,799.78
Total operating expenses	39,560.25
Gross profit	$17,239.53
Allowing 4% interest and 20-year sinking fund	16,292.00
Net profit	$ 947.53

The total quantity of garbage received was 20,710.74 tons, so the net profit amounted to about 4.57 cents per ton.

Garbage, however, is only one portion of town refuse and incidentally it may be mentioned that the householders in this large city have to dispose of their refuse, other than garbage, by arranging with any one of the 140 private contractors.[4]

Columbus is now installing a Sterling destructor to cremate rubbish only. Natural gas is available and consequently the proportion of ashes is stated to be small.

Garbage reduction plants are capable of being operated with profit, in cities of over 100,000 inhabitants. Mr. C. O. Bartlett, however, expresses the opinion that any small place producing one ton of garbage per day can be successfully treated in this manner.[5]

A full description of the reduction plant erected at Boston for the Boston Development and Sanitary Company is to be found in the Engineering Record of May 10th, 1913, and of the Columbus plant in Mr. Irwin S. Osborn's report of January 1st, 1913, to which those interested in this process are referred for further particulars.

A number of towns in Britain have adopted the Lightning Dust Manipulator, for instance, Southwark, a large borough in London, Halifax, Hove and others. The process consists in pulverizing the raw refuse into manure. This is done by means of high speed revolving hammers striking the refuse against the breaking block and a final disintegration effected by trituration between the hammers and the grinding plate. Southwark sells about 20,000 tons of manure annually. The manure is similar to black mold, and as the Southwark works are located in a populous part of London, and the plant has recently been extended the process is practically inoffensive. Hove is a large fashionable seaside resort in South England and Halifax is a large commercial centre in Yorkshire.

The text of this paper is Refuse Destruction and the remainder of the writer's observations will be confined to it.

For the sake of a clearer definition, furnaces operated at a temperature of about 1500 degrees Fahr. or less, will be called incinerators, and those which have a working temperature of over 1500 degrees will be called destructors. In America these furnaces are called low and high temperature incinerators, respectively. It seems preferable to know what is referred to by a distinctive name, rather than by a qualifying term which is often omitted.

Fire is the oldest and best known method of disposing of offensive rubbish. It has been adopted by all races and in all ages, with more or less satisfaction. Burying offensive matter is another ancient and effective way of getting rid of such matter.

The first engineer who successfully designed a furnace to effectually destroy town refuse by fire was Mr. Alfred Fryer, of Nottingham, England. This was in 1874. He built two such furnaces in Manchester in 1876 and these have been extended and improved and are still in use, which fact, at least suggests that Fryer had evolved a scheme based on right principles.

This innovation, however, met with a hostile reception. The public prejudice against the adoption of such furnaces was so strong that it is surprising they survived.

Following Fryer there were several aspirants who claimed to have designed furnaces superior to Fryer's; for example, Pickard's "Gommand," Wilkinson of Birmingham, Healy of Brighouse, Heard of Paddington, Burton of London, Stafford and Pearson and others, but Fryer's furnace held its position. These and some which were designed later on, were of the incinerator class—low temperature, slow burning, producing soft clinker and obnoxious gases. Mr. Charles Jones (Ealing) in 1885 introduced his "fume cremator" which was an ample proof that something was needed to improve the combustion.

Mr. William Horsfall in 1887 brought out the first high temperature furnace, which improvement gave a new impetus to the process. Horsfall also improved the furnace by arranging for a front exhaust of gases, by which means all gases had to pass over the active grate before being discharged and by so doing the fume cremator was found to be unnecessary and was ultimately abandoned.

From 1887 to the present time many improvements have been introduced, such as steam jet blowers, forced air draft, regenerators or air preheaters, continuous grates, mechanical feeders and clinkering, dust catchers, steam producers, and so on. As each maker has devised certain features in connection with furnaces, etc., they will be referred to collectively as far as possible.

Incinerators, then, are the survivors of the earliest types and destructors are the later developments.

Incinerators are furnaces capable only of slow combustion and require some form of drying-hearth or device for reducing the moisture contained in the refuse, preparatory to cremation. Some incinerators are charged with large quantities of refuse at one operation, the result being the lowering of the temperature of the furnace, the prolonging of the period of cremation as the combustion is more often local than general, the passage of green gases and the production of soft clinker and little steam. An analysis of the gases and a record of the maximum and minimum temperatures in incinerators will doubtless show that the work done is not altogether satisfactory.

Experience has shown that with destructors, the same as with other furnaces, the percentage of carbon dioxide, oxygen and carbon monoxide contained in the gases in the main flumes, is in proportion to the completeness of the combustion of the fuel and the carefulness of firing and clinkering.

It is manifest that not even the best coal-fired furnace can produce satisfactory percentages of the above constituent gases of combustion unless the temperature of the furnace is uniformly maintained, the range of heat fluctuations kept as small as possible, the quantity of primary and secondary air supplied is controlled to satisfy as nearly as practicable the requirements of the fuel used, and that the fuel is charged in small and regular quantities. Although coal is not usually quite constant in its calorific quality, it is vastly more so than town refuse, and if care is needed in the case of coal-fired furnaces, it is reasonable to advocate somewhat similar care in the cremation of refuse, if scientific and sanitary results are to be achieved.

Many incinerators require coal or other fuel to assist in the combustion of refuse, although the proportion of combustible matter in such refuse approximates that contained in refuse in other places where with destructors no other fuel is required or used, and good clinker and power are produced.

Engineers have during the last century developed the design of coal furnaces for steam raising and countless other purposes. Different grades of coal require different types of grates, etc. It would not be expected that a grate designed to burn steam coal with the maximum of efficiency would produce good results if bark were consumed.

A prudent manufacturer who requires a furnace for any ordinary industrial purpose would ordinarily adopt one that has already proven efficient, and if for any special purpose which needed some experimentation, he would start where others had left off (unless he had good reasons for doing otherwise) and so make use of whatever knowledge that was available.

Bearing in mind what has been achieved in many parts of the world with destructors, it would seem inadvisable to erect incinerators.

The more municipal engineers investigate this important problem, the more readily they will appreciate the necessity for the fullest consideration of the capabilities of various types of furnaces which it is contemplated to install.

There are several makes of destructors and incinerators on the market, and the writer does not propose to exploit any particular one. Each maker claims to have some features of superiority over others and doubtless some do possess certain advantageous qualities.

The original furnaces were top-fed and some are now being built on this plan, but in course of the last ten years or so back feed and front feed arrangements are found to answer rather better. Top feeding allows of mechanical labor-saving devices to be used, but even then it entails more arduous labor to the men below in raking in the material by long rakes over the fires. Back feeding was introduced in 1891 and is claimed to be under better control, whilst front feeding means a better concentration of labor. Conditions will vary in different places and these must be taken into account when deciding the method of feeding.

Destructor furnaces require a strong draft in addition to the normal pull of the chimney, although as one writer stated that since it has been demonstrated that incandescence can be maintained apart from the use of fans and regenerators, the question to be considered is whether it is good practice to run machines which absorb up to 15 per cent. of the total steam produced[5]. The steam jet is a simple, effective and economical blower, and the fan, being entirely mechanical, is more subject to wear and tear and liable to breakdowns and therefore should be in duplicate. The furnace pressure should be in balance, that is, the force of the blast under the furnace should be slightly in excess of the draw of the chimney, so as to render the intake of air at the doors during the time charging or clinkering takes place, as nearly nil as possible. The aim, nevertheless, of the furnacemen is to have these doors opened as few times as possible.

The advantage of either forms of blast does not appear to be very pronounced and to provide for all contingencies the makers now usually include both in recent installations.

Preheating of the primary air is claimed to be of considerable value. The air after being preheated absorbs the moisture in the refuse most readily, and this is found to be done sufficiently quickly that refuse can be cremated without the intervention of drying-hearth. In ordinary steam boiler practice preheated air is found to be of much value, for it increases the amount of water evaporated per hour. Brislee[6] gives an example of the advantage of preheated air. Two boilers were tested with the following results:

	Number 1 Boiler		Number 2 Boiler	
	cold air	hot air	cold air	hot air
Weight of water evaporated in pounds of water per hour	22910	40966	15800	24600

The increased evaporation was due to the extra heat brought into the furnace and the increased rate of combustion of fuel due to it.

In the case of the boiler No. 1 the evaporation was increased 79 per cent. and the No. 2 55.4 per cent.

Brislee points out that if air is heated before combustion is allowed to take place, then the heat in the air is added to the heat of combustion, and the quantity of heat available for raising the temperature of the product is therefore greater. In other words, conditions being equal in other respects, the preheating of air means economy of coal and the increased output of the boiler.

In destructors, regenerators, however, do not constitute the only method of preheating of air. Regenerators consist of stacks of pipes, through which the hot gases pass out on their way to the chimney and around which the cold air passes into the furnaces. The sensible heat of the hot gases is partially imparted to the cold air and in this way the temperature of the air is increased from 200 to 300 degrees or often more. This, of course, means the conservation of heat which would otherwise be lost in the chimney. Such regenerators offer some obstruction to the outgoing gases and to the incoming air, and to overcome this it is necessary to absorb some energy in driving fans. About 5 to 10 per cent. of the total steam produced from the refuse is thus utilized. Regenerators have in some instances been taken out for different reasons. It is easy to arrange for the primary air to be heated by passing it through flues built in the walls of the furnaces. This is being done in gas works practice and has been found to be very effective. Indeed, such method of preheating air or an adaptation of the idea is provided in some destructors. Incidentally, the air required for the furnaces is taken from the vicinity of the refuse and by this means the building is ventilated.

Continuous grates in one chamber are supplanting individual cells and grates and the advantage is evident. In the case of individual or single cells when refuse is charged into the furnace, it has the tendency of lowering the temperature of that cell, and the effectual mixture and burning of the gases must take place in the combustion chamber; whereas in the case of the continuous grates, two or more grates are built side by side in one chamber with independent ash pits beneath. When any refuse is charged into any one of these grates, the cooled gases therefrom are mingled and burnt in the furnace itself and no green gases can escape into the combustion chamber without first passing over an incandescent body. Meldrum's Simplex Destructor was the first constructed on this principle and its usefulness was appreciated by other makers. Heenan and Froude, Horsfall, Fryer, Dawson and Manfield and other destructor builders now design some form of continuous, twin or series grates.

Mechanical stoking and clinkering and other forms of labor-saving devices are installed in a number of destructors. Boulnois and Brodie's charging trucks, Marten's charging apparatus, Horsfall's tub feed, Heenan and Froude's hydraulic feeder and others are examples of the methods most in use. Heenan and Froude's trough grate and hydraulic ram clinkering machine and Sterling's clinkering grate are installed in many plants. According to Mr. Fetherston's report[7] the arduous work of charging and clinkering at the Clifton (New York) destructor has been reduced by the use of the hydraulic ram charger and clinker and trough grate. The following figures are extracted from his report.

COMPARISON OF WORK ELEMENTS. OFFICIAL TESTS.

Plant. Both in New York	Cost per ton supervision and labour.	Pounds burned per furnace-man per hour.	Pounds burned per sq. ft. per hour.	Perc'tge of time furnace door open.
West New Brighton, 1908.	$0.76	1357	54.3	73.7
Clifton, 1913	$0.41	3330	144.2	5.1

Mr. Fetherston, however, expresses his opinion that some time must elapse before the complete economy of the mechanical device is demonstrated.

Conveyors have been tried in several installations, but owing to the heterogeneous character of the refuse, they have not always been found to answer. The same remark applies to refuse elevators, etc. The there buckets and rake elevators in use at the Hackney destructor (London, England) capable of raising 10 to 12 tons an hour, are found to be very expensive to maintain and are liable to serious breakdowns.[8]

Hoppers or storage bins above the destructor furnaces are often found to be unsatisfactory owing to the tendency of the refuse to bind and arch over the opening, and the bulky nature of the refuse often renders the hoppers inadequate in capacity, in which case some city authorities store the refuse in the carts or wagons and thus obviate creating a nuisance. In some cases the refuse in bins tends to ignite and cause an emission of noxious gases. In recently built destructors the hoppers are located behind or in front of the furnaces and are sufficiently large to hold one or more days' supply. Such a position is both cool and handy for hand firing.

In the more recent developments of destructors the authorities have observed that it was possible to derive considerable steam power. The ordinary steam producing capacity of destructors is calculated at one pound of steam for each pound of refuse burned and as one horse power may be based on 30 pounds of steam per hour, it will be seen that one ton (2,000 pounds) will on the above basis produce 67 horse power, but a large quantity of steam is required for the plant itself, so that the net quantity of steam available for other purposes is less.

There are plenty of instances where the production of steam has exceeded one pound per pound of refuse.

Official tests made at the Clifton destructor in 1913 with a winter mixture of refuse gave a gross equivalent evaporation from and at 212 deg. Fahr. of 1.00 to 1.11 pounds at a pressure ranging from 117 to 126 lbs. per sq. inch, but at the New Brighton destructor the results were 1.10 to 1.41 pounds of steam at a pressure of 130 to 137 lbs. per sq. inch. The production of steam during the year 1911 was 1.23 pounds per pound of refuse.[7]

In Milwaukee the evaporation was 1.34 to 1.45 pounds and at Westmount, P.Q., from 1.48 to 2.11 pounds.[4] In Calgary, Alta., the average evaporation at tests was 1.13 pounds. In Darwen (England) the average evaporation during the year was 123 lbs., whilst on a test when burning unscreened refuse and slaughter house refuse was 1.55 pounds of steam from and at 212 deg. Fahr. In Huddersfield (England) with one part of sewage sludge and two parts of refuse 1.4 pounds of steam were obtained.

A test was made in Lochdale, England, for the purpose of comparison. By using ordinary coal slack having a calorifi value of about 12,500 B.T.U. 7.33 pounds of steam were produced from and at 212 deg. Fahr., as compared with 1.97 pounds from refuse.[9] At Montgomery (Alta.) in 1911 the following test results were secured: 1.37 pounds of steam per pound of refuse; carbon di-oxide in the waste gases 11 per cent:; temperature in combustion chamber 1920 deg. Fahr.; the refuse consisted of 25 per cent. ashes, 42 per cent. garbage, 13 per cent. rubbish, and 20 per cent. manure.[2]

The steam produced by burning refuse is utilized for a variety of purposes, such as pumping sewage, or water, generating electricity, etc.

Part of the steam generated from refuse in London, Ont., is used for heating the Victoria Hospital which is situated fifty feet away. In one city 72 million foot pounds of energy is derived from every ton of refuse and used for pumping sewage. In Liverpool and Rotterdam, for example, the electric energy generated is used for street railway operation. In West New Brighton and Clifton plants already referred to, a large quantity of steam is not utilized owing to the fact that the New York City charter prohibits its sale and consequently no revenue can be derived in this manner. This represents a loss of about $7,500 per annum. The quantity of refuse burned at each of these places is about 9,500 tons a year. In Westmount, P.Q., the destructor is an auxiliary enterprise operated in the same building as the municipal electric lighting plant, the steam generated by the cremation of the refuse being used in the production of electrical energy. Messrs. Hallock and Runyon, the engineers who were appointed to report on the disposal of refuse by the city of Newark,[4] stated that the total revenue in 1910 for electric lighting and destructor plants was $102,149.17, and the total cost of operation of the combined plant was $75,426.38, leaving a net profit of $26,722.79. The operating costs include all capital charges and depreciation. The cost to the Health Department for the refuse destroyed was $9,449.06 for the year. The population of Westmount is about 16,000.

One incidental result of good steam production is the production of good clinker, which can be used for many purposes. Low temperature cremation results in soft clinker which is not only useless but objectionable, as it cannot be used and it often contains partially consumed organic matter. Clinker should be well fused and vitrified and this can only be produced by maintaining a uniformly high temperature in the furnace.

Good clinker is used for making pavement slabs, for sewage filtering media, brick making, crushed into sand and mixed with lime for mortar, etc.

Reference has already been made to steam production. In the earlier plants the boilers were placed in the furnace directly over the fire, but it was found that the cooling effects of such boiler militated against the successful cremation of the refuse. The next step was to place the boiler between two cells and although better results were obtained, the makers in later installations have located the boilers beyond the combustion chamber. By this means the maximum temperature is secured and the gases adequately combusted before coming into contact with any cooling surfaces. The figures quoted point to the possibility of developing considerable power by the high temperature cremation of refuse. If due attention is paid to the fundamental requisites of a destructor the cost of operating the same can be materially reduced by the sale or utilization of the steam and hard vitrified clinker produced.

In conclusion, the author has observed that some disappointment has in places been experienced owing to the makers' claims being exaggerated and impossible of realization. It would of course be folly to decry every new device, arrangement or design, until it has been put to a practical test, for that would be tantamount to placing an embargo on all legitimate developments, but experiments are costly and occasionally disturbing as was recently found to be the case in a large plant in North America, whose designers received due publicity in engineering journals. The achievements that were going to be accomplished fell short and the works are now being improved.

The evolution of the destructor has been slow and expensive and the results of experience in all parts of the world has greatly assisted the makers in deciding upon the arrangements, capacity and construction best suited for the refuse produced in different places in different climes.

New York, Westmount or other destructors in the East may not be quite suitable for Western refuse, and doubtless this is the case. Each city has its own problems to solve and it therefore behoves the authority contemplating the installation of a destructor or incinerator to take the fullest possible advantage of the experience of others under similar conditions and of the plant best suited to satisfy its own specific needs.

FOOTNOTES:

(1) Report of the City Waste Commission of Chicago, 1914.
(2) Refuse Disposal in Small Cities and Towns, by Samuel A. Greeley, Illinois Society of Civil Engineers, 1913.
(3) Journal of Cleveland Engineering Society, March, 1914.
(4) Report on Disposal of Refuse, Newark, N.J., 1912.
(5) Surveyor, January 31, 1913.
(6) Brislee. Introduction to study of fuel, 1912.
(7) J. T. Fetherston, New York, Feb. 1914.
(8) Journal of Institution of Municipal and County Engineers, July, 1914.
(9) Refuse Disposal and Power Production, Goodrich.

A patented composition for covering floors, walls, and roofs, and for lining reservoirs, cisterns, baths, etc., consists of one part of Florentine magnesite cement (made by calcining and grinding a volcanic rock found in Tuscany) and three parts of a mixture in about equal proportions of sawdust, ground cork, asbestos, and pumice, and, if desired, ground paper, the whole being mixed with a solution of soft soap.

At Lyons an artificial wood has been devised, consisting in transforming straw into a solid material having the resistance of oak. The straw, after being cut into small pieces, is reduced by boiling to a paste, to which certain chemicals are added. When the paste has been reduced to a homogeneous mass it is put into presses, and planks, beams, laths, and mouldings of all sizes are readily made. This new material can be sawn like natural wood. As a fuel it emits a bright flame and little smoke. It is further stated to be adaptable to the manufacture of matchstems.

HAVING in mind the suggestion looking to the formation of a municipal engineering corps, advanced editorially in our issue of September 2, it is of interest to learn that Mr. George Janin, chief municipal engineer of the city of Montreal, has offered to raise an engineering corps for active service in Europe. As outlined in a letter which Mr. Janin has forwarded to the Minister of Militia, the plan is to organize a corps of about two hundred men, chiefly engineers—and at least those with sufficient technical training to engage in the bridge building, mining and other operations which fall to the lot of military engineers. Each member of the corps, Mr. Janin states, would have a command of both French and English. Mr. Janin is a Frenchman and came to Canada from Paris about twenty years ago. He is now a British subject, and the proposed corps of two hundred men would be enlisted under the British flag. Mr. Janin has both a son and a son-in-law serving under the French colors.

Injection of Cement Grout into Water-Bearing Fissures*

By Francis Donaldson, New York

THE direct injection of cement grout into water-bearing fissures as a means of checking or stopping the flow of water into shafts and tunnels has been experimented with for a decade or longer, and seems to have been first attempted in Europe. It is only lately, however, that the process has been entirely successful. This success has been accomplished on the Catskill Aqueduct, now under construction by the city of New York. This aqueduct includes a number of deep pressure tunnels, reached by shafts for both waterway and construction purposes. In portions of these shafts and tunnels considerable underground water was met. The contract for the first of these tunnels was let to the T. A. Gillespie Company; this section is known as the Rondout syphon. It leads under the Rondout valley at a depth of from 400 to 800 ft., and is about five miles long. The engineers expected that considerable water would be encountered, but fortunately this was not the case except at one shaft, known as No. 4, which penetrated the rock at a junction between limestone and conglomerate.

Water-bearing fissures were encountered almost immediately. At a depth of about 200 ft. a flow of 1,500 gallons per minute was struck. The shaft then contained as many pumps as could be used, and it seemed impossible to sink it further. After vain efforts had been made to proceed, John P. Hogan, a division engineer of the Board of Water Supply, suggested that a cementation of the fissures be tried. The process was attempted for the first time in this country.

Since the shaft was partly full of water it was necessary to drill holes with a diamond drill. Platforms were placed on the timbers at the water level, the diamond drill was installed, and six 90-ft. holes were drilled in the bottom of the shaft. Several car loads of cement were pumped through these holes into the fissures, the drill casings being used for grout pipes. This largely cut off the flow of water from the bottom and sinking could then proceed. After that, water-bearing seams were grouted as soon as encountered, and the contractor was able to finish the shafts and tunnel within the contract time. Shaft No. 4 was a rectangular, timbered construction shaft with no concrete lining; consequently it was impossible to cut off any of the water coming in from above the point where grouting was first attempted. On this account large volumes of water had to be pumped until the tunnel was finally sealed.

At the next wet shaft the writer had to do with, advantage was taken of the experience gained at shaft No. 4. At this second shaft, No. 4 of the New York City syphon, good progress was made until a depth of about 100 ft. was reached. The first hole drilled in the bottom below this depth struck a stream of water; the flow amounted to about 150 gallons per minute. This was plugged. It was found that each of the twelve holes in the sump cut encountered the same stream of water.

As soon as each hole cut the water-bearing seam it was plugged with a tapered wooden plug. After all the holes in the sump had been drilled and plugged in this way the grout connections were made one at a time, so as to restrict the flow of water into the shaft. Each connection was made with a piece of 2-in. or 2.5-in. iron pipe about 3 ft. long, threaded at one end and given a long taper at the other. The tapered portion was made rough on the outside by nicking it with a chisel. A heavy iron stopcock was screwed to the pipe, the tapered end wrapped in several thicknesses of burlap, the wooden plug removed from the drill hole and the tapered pipe driven in, the stopcock being left open. This was the most exciting and the wettest part of the job. After the pipe had been driven in hard the stopcock was closed.

The Grouting Machine

In this case connections were placed in all the wet holes before grouting. The grouting machine or tank used on the aqueduct was the Caniff machine, in which the grout is mixed by air. It is built like an air lock with a door on the top through which cement, sand and water are introduced, and has a 2-in. discharge opening in the bottom and air connections top and bottom. The discharge opening is connected to the grout hole by a heavy rubber hose. Another 2-in. stopcock is placed at the outlet of the tank, and a 2-in. by 1-in. tee is placed between the hose and the cock attached to the pipe in the drill hole. Into the side opening of this tee a 1-in. stopcock is screwed.

The machine is installed at the bottom of the shaft, and is connected to one of the holes and also to the high-pressure air supply. The 2-in. stopcock on the machine is closed and the other is opened. The door in the top is opened, a sack of cement, three or four buckets of water, and (if the cavity to be filled is large) a sack of fine sand are poured in, the air connection at the bottom is opened and the air allowed to bubble through and mix the grout. Then very quickly the door is closed, the lower air connection is closed, and the discharge connection and the upper air connection are opened, and the air enters and drives the grout into the cavity. A man stationed at the 1-in. stopcock keeps opening it a crack; when air shows instead of grout he closes the 2-in. stopcock and the machine is recharged. If the cavity is open the charge is pushed in in three or four seconds. By working continuously more than 1,000 batches can be placed in twenty-four hours.

The grouting of the fissures was successful and sinking was resumed. About 50 ft. further down another water-bearing fissure was drilled into, and this, instead of being open, was filled with sand formed by the crushing of metamorphic gneiss due to folding; this sand was carried up out of the drilled holes in large quantities by the water. Grout will not permeate sand, and it was necessary to continue drilling holes and pumping in grout, increasing the pressure at the end from 100 to 400 and 500 lbs. to the square inch. The sand was tamped so full of cement that when cut through it was compacted like sandstone and contained balls of grout from the size of a fist to as large as a man's head.

The most difficult grouting on the aqueduct was done on the Hudson syphon, which is a deep syphon tunnel under the Hudson River at a depth of 1,100 ft. below tidewater. The shafts were sunk by the city forces, after which the contracts for the driving and lining of the tunnel and lining of the shafts was let. About 150 ft. from the foot of the east shaft the heading cut a water-bearing fissure which flowed about 300 gallons per minute . The full flow did not develop until the cut was blasted. The problem then was to grout this flow against a hydrostatic pressure of 500 lbs. per square inch, with no solid rock to which to make grout pipe connections. This problem was finally solved by the construction of a concrete bulkhead 8 ft. thick across the full section of the head. The concrete was mixed in proportions of 1:2:4, and was heavily reinforced with rails set into holes drilled laterally into the sides, roof and floor of the tunnel. Grout pipes leading into the fissure were set through the bulkhead. After the concrete had set for a week, grout was forced into the fissure, first by the pneumatic process with a high pressure air compressor, and finally by means of a high pressure plunger pump which forced water instead of air into the grout tank. Pressures were reached in this way up to 1,000 lbs. per square inch.

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*From the Transactions of the American Institute of Mining Engineers.

In driving or sinking through rock containing a large number of seams carrying small quantities of water, it is not practicable to stop and grout each seam as described above. In this case it is advisable to increase the section of tunnel or shaft sufficiently to allow for a heavy concrete lining. Drains should be provided opposite all the water-bearing fissures to carry off the water while the lining is being placed. After the concrete has secured sufficient strength, the drains may be grouted. By a combination of these two methods it should be possible to penetrate any firm rock, no matter how much water it contains.

Canadian Contractors and Their Work

Mr. John W. Doty, Montreal

ONE of the most prominent figures in engineering and contracting circles in Canada to-day is Mr. John W. Doty, of Montreal, the active head of The Foundation Company, Limited, of Montreal and Vancouver, a company which specializes in the construction of heavy foundation work, particularly where this involves more than the usual difficulties. Much of the success of the work which this company has done is a result of Mr. Doty's efforts.

Mr. J. W. Doty.

Mr. Doty is the eldest son of the late Fred W. Doty, of Toronto. He was born in the Queen City in 1879 and gained much valuable experience in his earlier days in the shops of the Doty Engine Works. His training for the engineering profession was secured at the Rensselaer Polytechnic Institute, Troy, N.Y., from which institution he was graduated in 1902. Entering the employ of The Foundation Company, New York, in 1903, in seven years he rose to the position of Chief Engineer. In this capacity he designed and supervised the construction of the foundations of many of the largest buildings on Lower Manhattan Island, as well as many important bridges, dams and mine shafts. Of the success of this work a large share of the credit naturally falls to Mr. Doty.

In 1910, he returned to Canada and entered the contracting field by organizing The Foundation Company, Limited, of which concern he is at present the head. This company has built the substructures of many of Canada's largest bridges. Among these are the C. P. R. Bridge over the St. Lawrence River at Lachine, Que.; the C. P. R. Pitt River Bridge in British Columbia, and the Government Highway Bridge at Newcastle, N.B. It has also constructed the foundations for several large buildings, power developments and mine shafts, where the conditions required unusual methods on account of the difficulty of construction, or where speed in operation was the prevailing factor.

The most unique piece of work yet undertaken in Canada—the righting and underpinning of the large grain elevators at North Transcona, Man. (described in detail in our issue of August 19, 1914) was planned and executed under Mr. Doty's supervision.

Mr. Doty lives in Montreal. He is a member of the Engineers' Club and of the Canadian and American Societies of Civil Engineers. He is Vice-President and General Manager of The Foundation Company, Limited, and President of The Doty Marine Engine and Boiler Works, Goderich, Ont.

Mr. Doty is typical of the Canadian who is doing much for Canada by securing the best of the scientific principles and methods of other countries and returning here to apply the knowledge to the development of this country.

Announcement is made of the death of Wm. de H. Washington, consulting engineer, New York City, well known as an expert and enthusiast in highway improvement. The late Mr. Washington was at one time in the Canadian consular service.

The Marathon Rubber Company, of Akron, Ohio, will establish a Canadian branch at St. Catharines, where the ratepayers have approved a by-law granting a factory site and assessment privileges. The company will erect buildings and plant at a cost of not less than $50,000 and will employ 100 men at the outset.

Mr. Ralph Modjeski, the well-known bridge expert of Chicago, has been retained by the Burrard Inlet Tunnel & Bridge Company in connection with the Second Narrows Bridge and is now in Vancouver in connection with the enterprise, gathering data for a report which he will submit at the end of this month.

Sir Donald Mann states that the Canadian Northern Railway programme of construction will be carried out as planned, despite the chaotic conditions brought about by the war. Track-laying north and west of Kamloops will be started at an early date, and steel laying from the eastern end of the construction is to be continued. The large force of men engaged in grading and other work will be kept employed. The section between Toronto and Port Arthur is practically completed. Steel is delivered for all the line in British Columbia. In this province the company has three thousand men at work.

MAINLY CONSTRUCTIONAL

EAST and WEST — FROM COAST to COAST

EASTERN CANADA

The Toronto city council will expend $480,000 on a garbage disposal plant. The scheme embraces disposal plants in three or four sections of the city.

Tenders have been called for the $100,000 city hall which is to be erected at Lachine, Que. The architect for the proposed building is Mr. J. E. Viau, Montreal.

Among recent Quebec charters we note that of La Compagnie de Construction de Maison d'Habitation Salubres, Limitee, Montreal, with a capital of $100,000.

The Hamilton Board of Trade has pledged itself to raise the money necessary to undertake the erection of the new Connaught Hotel, estimated to cost one million dollars.

Foundation work has been completed for the new church which is to be erected at Quebec for the Redemptorist Fathers. The construction of the building will be frame and stone. The architect is Mr. R. P. Lemay, Quebec.

Opinion is gaining ground that work on the Toronto-Hamilton permanent highway will be started in the near future. It is expected that the undertaking will give employment at the outset to not less than five hundred men.

Operations are in progress on the new Charlotte Street school building which is being erected at London, Ont., at a cost of $100,000. The general contractors are J. Moran & Son. The building will be two-storeys high, of brick construction.

Plans for an extension of No. 2 elevator of the Montreal Harbour Commission have been submitted to the Commissioners. An addition was recently made to the eastern portion of this elevator, and the proposed extension is to be on the western side.

Constructional operations are well advanced on the apartment block which Messrs. Port Arthur Buildings, Limited, are erecting at Port Arthur. The general contractors are Messrs. Marsh, Hutton & Power Company, Limited, Port Arthur. The building is to be of reinforced concrete terra cotta and brick construction.

In view of present unsettled conditions, the directors of the National Brick Company of Laprairie, Montreal, have decided to defer payment of the dividend on the common stock. The opening months of the season promised a very satisfactory amount of business, but with the declaration of war, orders fell away, and the directors naturally desire to husband their resources. The Delson Junction plant is still in operation.

At a meeting of the Montreal Builders' Exchange called with a view to considering the situation brought about by the war, there was much discussion of the problem of getting money from the banks and securing cheaper labor. Several contractors declared that building cost more in Montreal than in any other city on the continent, owing to the high cost of land, labor and materials. Incidentally it was mentioned that the Unions would allow of no cut in wages, and that the men would rather lie idle than permit any reduction of the present scale. Mr. John Quinlan criticised severely the whole system of financing building operations on borrowed money. He said that the solution of the problem was the issuance of small bonds so that people with money in the banks could invest in them at a better rate than the banks allowed. The Exchange elected a committee to draw up a definite plan of action and report at a later meeting.

The town of Joliette, P.Q., is about to improve its water supply, plans having been drawn up by Messrs. Surveyer & Frigon, civil engineers, Montreal. The present power house is to be altered, and two hydraulic pumps (each of a capacity of 1,000 gallons per minute), and a turbine are to be installed. The pumps will work at a pressure of 130 lbs. The dam on the L'Assomption River is to be rebuilt of concrete. The platform of wood is to be substituted by one of concrete. A wood stave penstock, 6 ft. in diameter, is to be constructed in place of the open flume. Concrete walls are to be built on both sides of the channel and new head gates placed in position. The whole work will cost about $50,000.

Messrs. Routly & Summers, of Toronto and Huntingdon, P.Q., have secured one of the largest surveying contracts of the season. This is to survey the contour of the new flowage above the Iroquois dam of the Abitibi Pulp and Paper Company. A little over a year ago Messrs. Routly & Summers surveyed the contour at elevation 820. The flooding then extended to McDougal's chutes at Matheson on the Black River and to Twin Falls on the Abitibi, distances of 20 and 11 miles above the dam. The height to which it is now proposed to raise the water will flood out both these falls and reach about seven miles above Matheson on the Black River, and ten miles above Twin Falls on the Abitibi. Messrs. Routly & Summers have Haileybury and Porcupine districts, and are now engaged on a large road contract in Huntingdon County. Both members of the firm are aggressive young Canadians—graduates of the School of Science, Toronto.

WESTERN CANADA

The Universal Drilling and Contracting Company, Limited, has been incorporated at Calgary with a capital of $1,000,000.

Moose Jaw, Sask., is the headquarters of the newly incorporated Anchor Elevator Company, Limited, which is capitalized at $100,000.

The Burrard Inlet Gravel & Dredging Company, Limited, Vancouver, is among the latest incorporations in British Columbia. The capital is $10,000.

The British Columbia Steel Works recently incorporated at Vancouver has acquired five acres of land, with three hundred feet of water frontage at Bridgeport, Lulu Island.

The city of Calgary has decided to proceed with its various constructional operations in the municipal field. The programme involves the expenditure of approximately a million dollars.

A start has been made upon the new provincial parliament buildings which are to be erected at Manitoba, at a cost of $2,000,000. The dimensions of the buildings will be 340 ft. by 320 ft. and the construction will be of Manitoba stone. The architect is Mr. F. W. Simon and the general contractors are Thos. Kelly & Sons, Winnipeg.

Work is well advanced on the three-storey brick apartment block which S. Lobel is building at Wolseley and Lipton streets, Winnipeg, at a cost of $100,000. The general contractor is H. Genser, of Winnipeg.

At Medicine Hat, operations are proceeding on the erection of the new plant of the Saskatchewan Bridge & Iron Company, Limited. When the plant is completed and equipped it will represent an investment of approximately $200,000.

The Imperial Oil Company, Limited, of Vancouver, have applied to the city council of Victoria, B.C., for permission to erect a fireproof storage plant in that city. The application has been considered favorably, and negotiations are proceeding.

The substructure of the new bridge which is being erected on Eighth Avenue, Moose Jaw, by the City Council and the Canadian Pacific Railway, is completed. The total cost of the bridge is placed at $109,000. The general contractors are Messrs. Carter-Halls-Aldinger Company, Winnipeg.

Work is in progress on the Alberta and Great Waterways Railway undertaking, for which the J. D. McArthur Company, Winnipeg, are the general contractors. Twenty-five miles of steel have been laid and ninety-five miles of grading have been completed. The cost of the undertaking is placed at five million dollars.

Foundation work is in progress on an apartment block which is being erected at Winnipeg by Mr. Daykin Scott, the owner and general contractor. The building will be four storeys high, 50 ft. by 140 ft. in dimensions, of brick construction. The cost is estimated at $100,000. Mr. E. Pain, of Winnipeg, is the architect.

Book Reviews

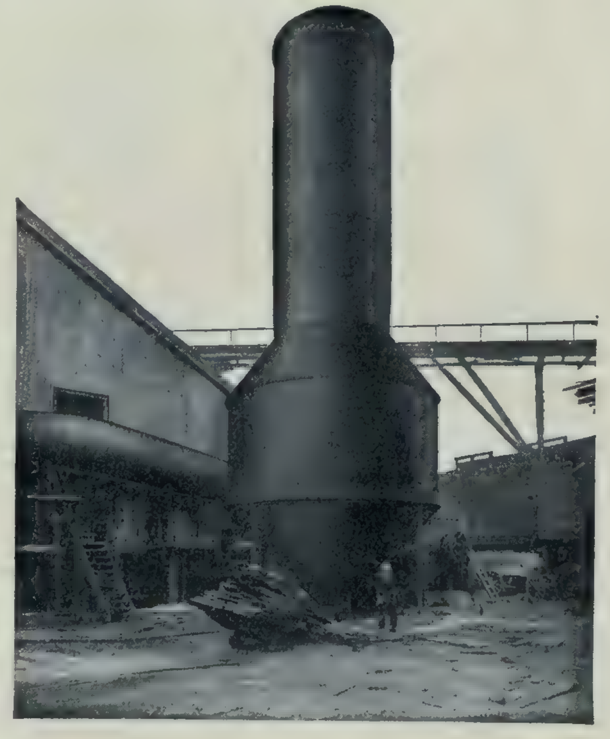
HISTORY OF BRIDGE ENGINEERING, by Henry Grattan Tyrrell (University of Toronto) Chicago. Price $5. The latest issue of this valuable work contains 480 pages and 330 illustrations. This book is valuable, not from a historical viewpoint alone but also as a work of reference, especially in the selection of economic types and the preparation of comparative designs and estimates. The majority of the illustrations are from original diagrams, sketches and photographs. Generally it may be said that this is a practical book of exact data, full of suggestions and information for engineers, contractors, designers and others identified with this particular branch of constructional activity. It being the only book on the subject in the English language, Tyrrell's History of Bridge Engineering may be accepted as a standard authority in this field.

Several million yards of Trinidad and Bermudez sheet asphalt pavements that have given a service of twenty years or more are illustrated and described in a booklet entitled, "Evidence," just published by the Barber Asphalt Paving Company. A score of cities are represented and wherever maintenance data were obtainable they have been given along with the date the pavement was laid and a photograph showing its present condition. The oldest of the pavements so described is the Trinidad sheet asphalt on Vermont Avenue, Washington, D.C. It is 35 years old. Something more than 1,000,000 square yards of asphalt paving in Washington, D.C., averaging 23 years of age, have cost 1.8 cents per yard per year for maintenance. New Orleans has several 30-year pavements. Buffalo has 1,200,800 yards of sheet asphalt 20 years of age or more and still in use. Among other cities that contribute to the census of more-than-20-year-old pavements are New York, Philadelphia, Boston, Chicago, St. Louis, Cincinnati, Columbus, Detroit, Omaha, Charlestown, S.C., Savannah and Louisville.

Unique Mechanical Draft Installation in a Lumber Mill

The Bloedel-Donovan Company, of Bellingham, Wash., have recently installed an unique and successful induced draft apparatus. The magnitude of the installation can only be appreciated by comparing it with the horse and wagon standing beside it, the wagon being only about one-half the height of the fan, while the collector is larger than an ordinary house.

This apparatus is guaranteed to collect all sparks and cinders. This entirely eliminates the fire risk. Cinders are caught in the collector and are diverted into a flume of water which empties into Puget Sound. The apparatus also enables the owners to keep clean lumber in their yards. They state that it will save them thousands of dollars a year for that reason. The cinders settling on the lumber together with the rain discolors the wood and greatly reduces its market value. This appearance is used in connection with boilers burning shavings and saw mill refuse. At the time the photograph was taken the boilers were delivering 2,300 h.p., which is greatly in excess of their normal rating. This increase in boiler capacity is due to the tremendous additional draft obtainable with the induced draft system. In some plants as much as 100 per cent. additional capacity is obtained by using mechanical draft.



Induced draft apparatus in a lumber mill (B. F. Sturtevant Company's installation).

Another advantage obtained is that steam pressure is kept constant at any desired pressure. When steam pressure tends to decrease the fan speeds up automatically and does not allow pressure to drop. This enables the plant to respond instantly to sudden demands for more steam. If another engine were thrown in there would be plenty of steam. With this system, steam can be raised from cold water very quickly.

The installation was made by the B. F. Sturtevant Company, of Hyde Park, Boston, Mass.

Contracts Department

News of Special Interest to Contractors, Engineers, Manufacturers and Dealers in Building Supplies

Waterworks, Sewerage and Roadways

Chatham, Ont.
The Waterworks Commissioners contemplate the laying of a 12-in. water main across Thames, also the putting down of three street hydrants. Estimates will be prepared. F. B. Adams is the engineer, and W. G. Merritt, city clerk.

Edmonton, Alta.
Edmonton, Dunvegan & B. C. Railway has offered to finance the construction of an 18-ft. pavement from Edmonton to their engineering shops, St. Albert Trail.

Esquimalt, B.C.
The municipal council is having plans prepared for construction of sewage system in Craigflower District, consisting approximately of five miles of sewers. Tenders for work will be called as soon as plans are ready. E. A. Ellis is clerk, and C. A. Toff, 211 Pemberton Block, Victoria, is engineer.

London, Ont.
Tenders will be received by Board of Control until 9 a.m. September 18th, for construction of the following vitrified sewers: approximately 1,029 ft. of 10-in. sewers with 20 manholes; 2,329 ft. of 8-in. with 20 manholes; 6,646 ft. of 6-in. private drain connections, also connections with gasket and cement joints. Plans and specifications at office of Engineer, Wm. N. Ashplant.

Tenders are being asked for construction of sanitary sewers as follows: Belgrave Ave., from Duchess to Grand Ave., Carfrae Cres., from Grand Ave. to Carfrae St., Gordon St., from Cheapside to end of street; Carlton Ave., from William St. to end of street; William St., from Grosvenor to Cheapside St. Plans and specifications at office of Engineer, Wm. N. Ashplant.

H. J. Glaubitz, Engineer, waterworks plant, is in the market for two water wheels, turbine, pumps and motors.

Millardville, B.C.
The ratepayers have passed a by-law providing for laying of watermains in Rochester and Austin Roads. E. H. Longly is municipal engineer.

A by-law for construction of water system at an estimated outlay of $8,499 has been defeated by the ratepayers.

Ottawa, Ont.
The report of Waterworks Engineer has been passed by city council for carrying out of $50,000 repairs to intake pipe. The work provides for (1) unwatering aqueduct other than by pumping; (2) connection of 40-in. and 42-in. pipes; (3) use of rock bolds throughout. Tenders may be called shortly.

Work is to start at once by day labor in connection with laying of a $13,000 pavement on Gilmour street for city council. F. C. Askwith is city engineer, L. McL. Hunter roadway engineer.

Bids received by city council for supply of concrete mixer have all been rejected and new tenders will be called.

Plans are drawn for the construction of wood block pavement on Augusta St., between Henry and St. Patrick, at estimated cost of $17,000. Quantities are, blocks, 3,600 sq. yds., curb, 350 lin. ft., headers, 145 lin. ft.

Regina, Sask.
The city council is trying to raise $50,000 for completion of reservoir of 5,000,000 gal. capacity, steel and concrete construction. J. M. McKay is superintendent of Waterworks Department.

The city council contemplates the construction of sewers and water mains to cost approximately $20,000, work to be done by day labor. Engineer is F. McArthur.

Stratford, Ont.
The Water Commissioners are commencing work on the construction of a 6-in. water main on Albert St. R. R. Lang is city clerk, and W. H. Trethway, sec.-treas. of Water Commissioners.

South Vancouver, B.C.
Plans have been approved by municipal council for carrying out of paving on 63rd Ave., from Ross to Main St., with gravel bitulithic 18 ft. wide, also other improvements to Manitoba St. Estimated cost $2,986.

Toronto, Ont.
Tenders are wanted for construction of several house drains in the east end, by A. McLeod, 57 Benlamond Ave.

The city council has adopted a scheme to construct a series of three or four incinerators in different parts of the city, at an estimated cost of $480,000, as recommended by the Board of Control. The scheme provides for total incineration of all garbage and refuse. Three projects were before the council, the other two being suggested plans (1) for total incineration in two incinerators, and reduction of garbage outside city, at an estimated cost of $676,000; (2) total incineration of rubbish and reduction of garbage in central plant located at Ashbridge's Bay. The estimated cost of this latter was $720,000. Tenders will be called as soon as plans are completed.

Work will be started shortly on the construction of concrete road to connect Toronto and Hamilton. Toronto will be asked to contribute $125,000 and Hamilton, $50,000, while the townships will be expected to subscribe $160,000 and approximately $140,000 will be raised by capitalizing an annual frontage and acreage tax.

Vancouver, B.C.
The municipal engineer, F. C. Fellowes, has submitted plans for construction of sewer in Alma Road, 40-in. in diam., from 4th to 7th Ave., and 30-in. diam., from 7th Ave. to Broadway, at an estimated cost of $15,000; also a sewer in Trinity, from Slocan to Nanaimo Sts., at a probable expenditure of $6,500. Mr. Fellowes has also recommended construction of sewers as follows: 19th Ave., to cost $1,600; 21st Ave., $3,800; 22nd Ave., $4,600; 23rd Ave., $3,400; 24th Ave., $2,850; and Carolina St., $8,500. Wm. McQueen is the city clerk.

City Engineer has completed estimates for constructing 42-in. sewer on Alma Road; cost $15,000, and a sewer on Point Grey Road, to cost $15,500.

Vernon, B.C.
Plans for construction of sewer extensions and disposal works for city have been approved by Provincial Board of Health.

Victoria, B.C.
A by-law has been carried for the construction of asphalt pavement on Dallas Road, between Erie and Simcoe Sts., and operations will start at once. Wellington J. Dowler is the clerk.

Welland, Ont.
A water pipe line costing $1,000,000 will be constructed according to press reports, by the Dominion Government. The line will carry water from Lake Erie to supply the towns of Welland, Merriton and Thorold, Port Robinson and Allanburg and the city of St. Catharines.

CONTRACTS AWARDED

Cayuga, Ont.
The contract for 1,800 sq. yds. of pavements has been given by the Town Council to Crofft & Walters, Cayuga, at $1,200. J. W. Sheppard is the Clerk and Mr. Kidd, Dunville, Engineer.

Eastview, Ont.
The contract for construction of sidewalks on various streets has been let to Loomis, McBean & Williams, Sussex St., Ottawa. Patterson & Byrne, Sparks St., Ottawa, are the engineers. Vitrified clay pipe will be required.

Esquimalt, B.C.
The contract for construction of sewer system in District "C" at a cost of $15,000, has been awarded by the municipal council to Hugh MacDonald, general contractor, at Victoria.

Kingston, Ont.
The Board of Works has recommended the award of contract for asphalt pavements on William, Aberdeen & Frontenac Sts., and University Ave., to Foley & Gleeson, Central Chambers, Ottawa, at $2.15 per sq. yd.

Ottawa, Ont.
General Supply Co. of Canada, Ltd., 356 Sparks St., has been awarded the contract for supplying Trench Rammer for city council.

ESTABLISHED 1886

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Alphabetical Index of Advertisers
Page 18

Vol. 28 **September 23, 1914** **No. 38**

Principal Contents

Meeting the Present with an Eye to the Future... 1179-80
Building Industries and the Future 1180
Activity in Great Britain 1181
Chilliwack, B.C., Sewerage Scheme 1181
Evolution of Modern Elevator Construction 1182-8
By Jas. Spelman, M. Can. Soc. C. E.
Cost Accounting and Its Importance on Construction Work 1189-90
By Leslie H. Allen
Concrete Highway Construction at Montreal 1191-2
Some Water-Works Engineering Mistakes 1192-3
By D. H. Maury
The Engineer and the Contractor—Their Relation on the Job 1193-5
The Preparation of Architectuarl Drawings 1195-6
New Post Office at St. John, N.B. 1196
Painting Concrete and Cement Surfaces 1196-7
Relative Values in Sanitation 1197-1200
By Geo. C. Whipple
The Decorative Value of Concrete 1200
Constructional News 1201-2
Industrial Notes 1202

Meeting the Present with an Eye to the Future

WAYS and means of meeting the situation brought about by the war must not be lost sight of in the optimistic view that hostilities are likely to be over at an early date and that business will soon resume its normal course. At all times we must do our best to impart confidence and optimism, but however sure we may be of the future we cannot evade the responsibilities of the present.

So it is that we commend the action of the Montreal Builders' Exchange in the efforts which they are putting forth to determine the most satisfactory course in the interests of both employer and employee. At the meetings which this Exchange has convened recently, there seems to have been unanimity of opinion regarding several fundamental aspects. In the first place it is agreed that if capitalists are to be induced to undertake new buildings they must be encouraged by reduced cost and that this reduction in cost can be brought about only by the careful co-operation of master and man. It seems to us that much more hinges upon such co-operation than is popularly believed.

The banks have been criticized for their unfavorable attitude in regard to the financing of new undertakings and it has been suggested that pressure should be brought to bear upon the Bankers' Association and the Minister of Finance—indeed the Montreal Exchange has appointed special committees with a view to approaching these authorities. But what pressure can be brought to bear? When the Exchange has such a good purpose in view we hesitate to criticize its action, but we fail to find any encouragement for expecting great things of the banks. These institutions have their own responsibilities. They have to hold themselves in readiness to meet the possibility of unprecedented demand, and most of them have government obligations which must be watched closely; moreover, if their funds were available for new constructional projects, probably they would be pleased to arrange terms of finance, as these could be effected on favorable terms.

If any impetus is to be given to constructional operations the momentum must come from within. Contractors, supply houses and workmen must be prepared to sacrifice uniformly. The contractor must cut his profits; the supply dealer must effect a revision of his schedule, and the mechanic must resign himself to the period of economy which will ensue upon a lower wage.

Hitherto, capital and labor have been opposed in their respective ends. Each has succeeded in face of, if not because of, the other's opposition. Now the order of things is reversed. If the men who are arrayed on the side of capital close their fist and the workmen take up the challenge, the result will be disastrous. As soon as there are no workmen, the wheels of industry cease to revolve. With no work in progress the stability of the country is gone and the interests upon which capital depends collapse like a pack of cards. Meanwhile, the workmen, with no work, and arrayed in opposition to capital, starve. These are only the fundamental principles of economics, but after all the whole structure of humanity is dependent upon the observance of the fundamental elements, and their violation brings the inevitable consequences.

This is somewhat of a digression, but it may serve to call attention to the seriousness of the action of some of the unions in refusing to consider any reduced scale of wages. At Montreal, the representatives of one of the labor organizations actually told a large contractor of our acquaintance that he would rather eat from the soup kitchen than have wages reduced one cent an hour. One can only characterize such an expression as foolish and the man who gave vent to it as a fool. Workmen are vitally interested in such efforts as the Montreal Builders' Exchange are making and they must co-operate with a view to affording a stimulus to constructional enterprise. The whole secret of such stimulus is lower cost. It has been suggested that there be a general reduction in wages to apply on all work contracted for during the last four months of 1914. We endorse the suggestion, knowing it to be only a temporary arrangement looking to the fulfilment of a wise purpose. It is one means of continuing employment and maintaining the stability of the whole business structure.

Mention building operations to the prospective builder now and he will probably offer as an excuse for postponement the existing high rates of interest. Offset this argument by telling him that the cost of building has been reduced to a figure which he will never see again in his natural life and it will set him thinking.

Certain it is that the various interests identified with constructional operations must do some hard thinking, and they must think quickly and wisely and well. A conservative, co-operative policy—inspired by that confidence which has built up British business to its present enviable position—**put into effect now** will meet the present situation and lead us to ultimate prosperity on a scale which will compensate for all temporary trials.

Building Industries and the Future

A Review of the Situation in the Old Country, by the London "Builder" —British Government Urged to Come to the Assistance of the Banks

DURING the long period of peace which followed the conclusion of the great Napoleonic struggle our industries had no continental rivalry to struggle against for sixty or seventy years, and could easily hold their own in neutral markets; but the enormous development of the United States and Germany during the last thirty years has resulted in steady pressure being directed to undermine our influence in neutral markets and to destroy our commercial position, and this has been largely helped by the organized support of Governments and banks. Whereas we produced more iron than any country thirty years ago, we have now sunk to the position of the third largest iron-producing country, having been passed first by the United States and then by Germany.

To a great extent this has been the result of factors which we cannot hope to cope with, such as the development of the almost boundless resources of the United States, coupled with an enormous growth of its population recruited from that of every country in the Old World. But the growth of Germany as a commercial power has been largely effected by the careful manner in which her industries have been fostered by her Government, which has enlisted the help of science in many of them.

The building industries are not largely affected by foreign competition, except in sheet and other forms of glass used in building, and in electrical work; but, as these industries require a large amount of expensive plant and would employ a number of men, we hope the opportunity may be taken to create a native supply for the building trade in these materials, while the subsidization of the glass industry in some form or other might be usefully considered.

With regard to steel, we trust that manufacturers will not raise prices unless it is absolutely necessary for them to do so, as this would operate in checking building enterprise; but we do not believe that large or substantial advances are likely to be made.

A shortage of spelter may affect some trades, but we hope this will adjust as time goes on; and this may be said with even greater confidence of timber, since many sources of supply will remain open and be available.

The chief obstacle to immediate prosperity in the building trade is, we have gathered, the withholding of the usual credit given by the banks, and this is a matter so essential to the prosperity of the trade that we consider a clear case has been made out for the benevolent action of the Government. To re-establish the normal machinery of credit will enable men employed in the second largest industry in the country to be kept employed, and will be infinitely cheaper to the State than keeping these same men in a state of unemployment. If the Government lost a little money in doing so—and we do not see why it should—it would save much in the prevention of unemployment. And it must be remembered that the good done does not affect employers and men alone, but a whole group of industries connected with building and entirely dependent on it. So that assistance given to the banks would be an exceedingly cheap method of securing an excellent result, and one which would have a material, though indirect, effect on the struggle in which we are engaged.

It would be but employing in an emergency the method which Germany systematically uses in normal times for the development of her industries. German banks, which act in conjunction with the Government, have supported German trade in circumstances in which no English banking facilities would have been afforded, and have been a great factor in her extraordinarily rapid commercial development. While we have been termed a nation of shopkeepers, the Germans have proved themselves to be a nation of commercial organisers by a system which can best be described as the union of Governmental and private enterprise. We have said we regard the prospects of the building trade as good, but to secure the result wanted the Government must be shown clearly how best the present difficulties can be met, and the building industries should make the state of things absolutely clear to those in authority.

"Considerable Activity may be Looked for in Great Britain," says Ferro-Concrete

"Instead of limiting the enterprises of local authorities and other public bodies and restricting labor and the output of plant and materials, it is plainly evident that the war will cause an immediate boom. On the suggestion of the Local Government Board, most of the corporations and district councils in the country have already decided to prepare and carry out important schemes of building and engineering in order that during the coming winter full employment may be found for every workman, and so that any men thrown out of work from other industries may be kept fully employed. Special facilities for the immediate execution of such schemes will be afforded by loans and by grants from the Local Government Board and the Road Board. Merchants and manufacturers of plant and materials for municipalities will act wisely in making preparations well in advance for the demands which will immediately be made upon them. It may also be mentioned that Parliament has passed the Housing (No. 2) Act, and that four millions sterling are to be spent in the erection of labourers' cottages. Moreover H.M. Office of Works have decided to proceed with all services in their charge, to employ as many men as possible to carry out such services, and to develop and expedite their building programme in any way practicable. The Commissioners of Works express the hope that private individuals, companies, firms and contractors will spare no effort to follow the policy of the Government in this matter."—Ferro-Concrete.

Sir George Foster's Advice

"What we cannot supply ourselves, let us purchase from Great Britain and other parts of the Empire. Let us covenant together to buy goods 'Made in Canada,' 'Made in Britain' and 'Made in the Empire.' Thus shall we give employment, and the profits of production to the Empire's home workers. Then let us find the details of what Germany and Austria have produced and sold to other countries, and set ourselves to supply as large a part of this as possible. Here are markets for hundreds of millions worth of products, the making of even a portion of which will keep our industries going and give employment to hundreds of thousands of our people. If consumers determine to buy only Canadian and Imperial goods, and producers to provide them at lowest prices and of good quality, a co-operative work of inestimable value will have been begun."—Sir George Foster.

A quick method of breaking up the granite setts or other material used between tramway tracks has been successfully employed in Cleveland. Previous to any track work, where it is necessary to break up the paving, a special plough is hauled by a service tramcar over the section on which the work is to be done. The plough consists of a heavy steel casting of suitable shape for lifting the paving blocks and for cutting the tie rods at the same time. It is pulled by a service motor car which is equipped with four Westinghouse motors and high-tension control. The weight of the motor car with load is about 50 tons. The weight of the plough car together with its counterweight is about 11 tons. Three men and the crew of the motor car are all that are needed to operate the machine. It has been found that with this plough 1,300 square feet of pavement can be broken up in one minute. On one occasion the pavement in a stretch of track 2,600 ft. long was removed in thirty-five minutes. Only such slight difficulties as the breaking of the cable which pulls the plough have been experienced up to the present. The plough is only used once or twice a week, for an hour's work with it will give enough track to work on for eight to twelve days.

Chilliwack, B. C., Sewerage Scheme

THE scheme for the sewering of the city of Chilliwack was designed by Messrs. Cleveland & Cameron, engineers, Vancouver, and the work is being carried out under their supervision by the firm of Messrs. Robert McLean & Company, contractors, Vancouver.

Chilliwack is situated on a level plain on the left bank of the Fraser River. During high water on the Fraser in the summer when the rise is extreme, the level of the city is below the level of high water. A most efficient system of dyking surrounding the greater part of the city site was constructed years ago. The average formation in the city consists in depths of seven to nine feet of alluvial deposit over-lying quicksand and gravel. Where the alluvium is of sufficient depth the work of sewering is about as easy as it is in any formation, but when the depth of the sewer penetrates the sand and gravel the work becomes one of exteme difficulty.

The necessity of providing for the draining of basements in the business part of the city causes the sewers to be laid a depth of over 10 feet, and for a considerable distance the system is below the quicksand.

The original scheme provided for the use of pneumatic ejectors at two or more points within the district, but the cost of these was prohibitive and the scheme being carried out consists of outfall works placed at sufficient height, pumping chamber at the lowest point in the district, and a series of sewers ranging from 12-in. to 6-in. in diameter, with a rising main from the pump well to the outfall works. The scheme is on the separator system of sewerage.

The cost of the works will be about $35,000.

The sewers are constructed with vitrified pipes, jointed with neat cement, with the usual manholes built in concrete at intersections and changes of gradient. The pumping chamber is constructed of concrete, the upper portion of which contains the pumping machinery. This consists of centrifugal pumps in triplicate, supplied by the Canadian Fairbanks-Morse Company, of Vancouver, driven by the Squirrel Cage type of electrical induction motors, the sewage from that point being delivered by the rising main to the outfall works on land on the bank of the Lilly slough. Each pump has a capacity of 200 gallons per minute against a total head of 33 feet. The outfall work consists of detrital chamber and separator chamber in duplicate, each provided with controlling valves for alternating the flow and for removing the solids. The detrital tanks are of the usual hopper bottom shape with surface scum boards.

By this combination over 90 per cent. of the solids in suspension are removed, producing an effluent sufficiently clarified to be discharged into a stream or for further purification on filters. The detrital tanks and separator are built entirely of concrete.

The above scheme provides for the sewerage from a population of 5,000 at the rate of 100 gallons per head per day.

The Evolution of Modern Elevator Construction[*]

By James Spelman, M. Can. Soc. C.E., Montreal

THE question of storing grain is probably as old as civilization. Since the time when men began to cultivate the land the resulting crop had to be held at least a twelve-month. Later on, the necessity of making the crops of a bountiful year last over into lean years led to the storage of the grain for longer periods.

Fig. 1 is taken from a wall painting in the Tombs in Thebes. It shows two granaries with conical domes that were used at one of the large houses. Fig. 2 is a cross section of some silos that were used by the early Egyptians, also taken from a recently discovered wall painting. In this are shown all the fundamentals of the grain elevator. The grain was received in the pile at the right of the picture and measured in a measuring basket by the man on the right. It was then carried by the other men walking up the stairs to the top of the bins, from which primitive elevators the modern term elevator leg has been derived. The grain was poured in at the top and taken out at the bottom when required, and the markings on the bin walls are supposed to indicate the character of the grain. The bins were not two-storey affairs, as might be judged from the illustration: the Egyptian method of showing that there was something in the background was to place it on top of what was in the foreground. Simple as this process is it conveys the idea of the modern elevator. The grain was received, weighed or measured, put into the different bins according to grade and taken out at the bottom. Prescott in his "Conquest of Peru" mentions that the Incas stored grain and that they sometimes had on hand a supply which would last the immediate neighborhood for ten years.

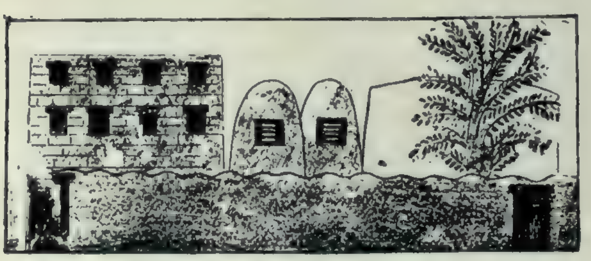

Fig. 1—Type of granaries built by the early Egyptians.

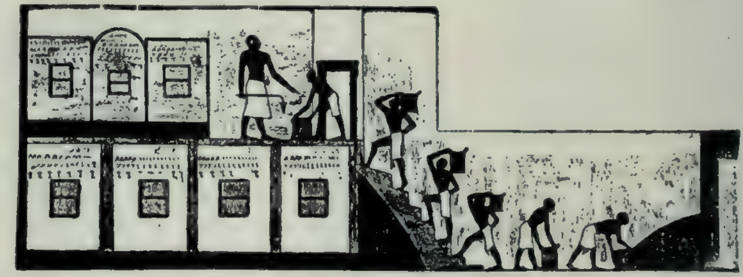

Fig. 2—Cross section of silos used by the Egyptians.

An elevator as built at present provides means for receiving the grain, places in which to put it and appliances for delivering it. It also provides machinery for weighing it both when it is received and when it is delivered. There are several kinds of elevators, the design depending on the location, the local conditions and the business that is to be performed.

An interesting problem arose during the construction of an elevator at Port McNicoll, as to the proper mixture of cement, sand and stone to be used in the concrete. The cost of the cement delivered at the mixer was $1.38 per bbl. and that of the gravel unloaded in the pile at the elevated track 38 cents a yard. The screened stone after passing through the screening plant was worth $1.70. There was so much of the sand that it was not considered as having any value except for filling purposes, and the cost of the concrete mixture would depend on the allowance which the railway company might be willing to make for it. About thirty per cent. of the pit gravel delivered was stone and seventy per cent. was sand. After washing, a very good sand with about twenty-five per cent. of voids was obtained. The mixture under these conditions would cost from $3.25 to $3.71 per yard for 1-3-5 mixture, depending on what was allowed for the waste. If thirty cents were allowed it would cost $3.25, and if no allowance were made it would be $3.71. After figuring on what the different mixtures would cost with different allowances for the waste it was found that if twenty cents were granted the cost of a 1-3-2 mixture would be the same as a 1-3-6 mixture, a most unique condition.

During the construction the supply of stone failed and it was decided to put in sand, the only objection being that the mortar would stick and not run out of the buggies. It was, however, possible to use enough stone to keep the buggies clean. The material averaged $3.38 a yard for concrete when placed over the mixers. The arrangement for mixing was good, the mixer being placed directly under the bins and discharging to buckets in the hoist tower which carried the material to the top of the building. Concrete was deposited in the bin walls for 80 cents a yard from the mixer, making the cost of the concrete in the walls about $4.20.

The Port McNicoll elevator storage house covers one acre, the entire building being of concrete and steel. Recently another unit of the same size has been added.

Years ago elevators were built principally of wood, as it was the cheapest material. In fact, up to about the middle of the nineties very little else was used. The elevator builder in most cases developed from a good carpenter. Not much technical engineering talent was employed, the ingenuity displayed being that of the natural mechanic. These men knew very little about grain pressures, but they soon discovered what thicknesses of walls were required for bins of various sizes and that if the bins were built too high the timber below would crush. The construction was gradually developed so that the minimum amount of material was used to carry the loads safely. The re-

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[*] Abridged version of a paper before the Canadian Society of Civil Engineers.

Figs. 3 and 4—Reinforced concrete elevator construction in progress at Manchester, Eng.

sult was that, in wooden elevators, loads were used that would not be tolerated by other engineers. For instance, the side pressure in some of the old wooden elevators was 600 or 700 pounds on oak. A strict interpretation of most city ordinances would make it necessary to add very materially to the amount of timber used in the ordinary wooden elevator. One of the reasons why such pressures can be used is that the load in the elevator is an ideal load. It comes on easily and is taken off easily, without shocks or jars of any kind.

To illustrate how closely men worked in those days, there was one elevator in which about 65 or 70 feet of cribbing was shown on the plans. The owner asked to have fifteen feet more put on. It was objected that the posts would shove up into the girders. He stated that he was only going to use the building to store oats, which were much lighter than wheat, and he therefore could afford to take a chance in building so much higher. The owner finally assumed all responsibility for the additional height and stated that he was not going to fill the elevator with anything but oats. Six months later the posts had gone two and a half inches into the timbers, and on investigation it was found that the first time the elevator was filled it was with wheat.

About the middle of the nineties there began to be a demand for the fireproof elevator. The increase in insurance rates and in the cost of timber led to the inquiry as to whether something better than wood could not be obtained. Steel was first used, then tile, and afterwards concrete. About the time that the building of fireproof elevators was proposed, those who were in the business of constructing elevators realized that they knew very little about grain pressures. It was all very well to build in wood, in connection with which experience had been gained, but in order to make a proper design for a building in steel, or tile, or concrete, it was very necessary to know what the side pressure and the down pressure and all pressures amounted to, at least approximately. At that time knowledge with regard to bin pressure consisted of one fact. Someone had demonstrated that if a bin were filled with grain the pressure at the bottom would

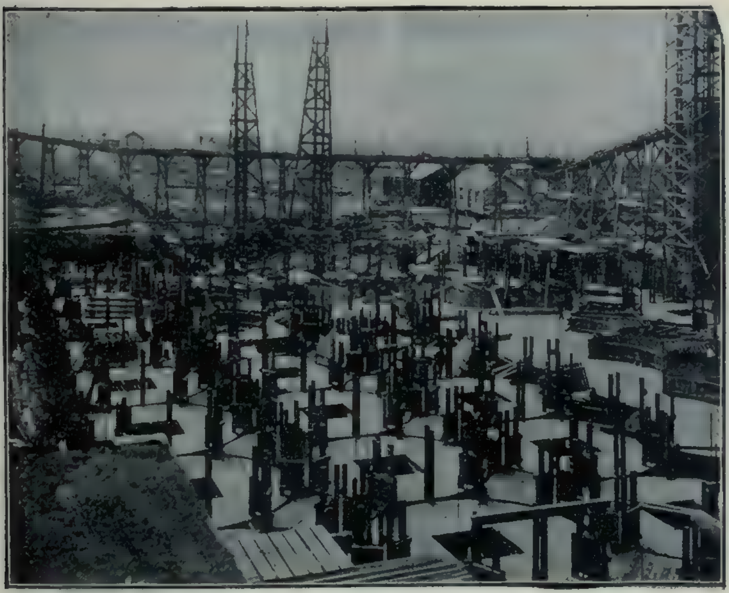


Fig. 5—Form work for bins at Fort William, Ont.

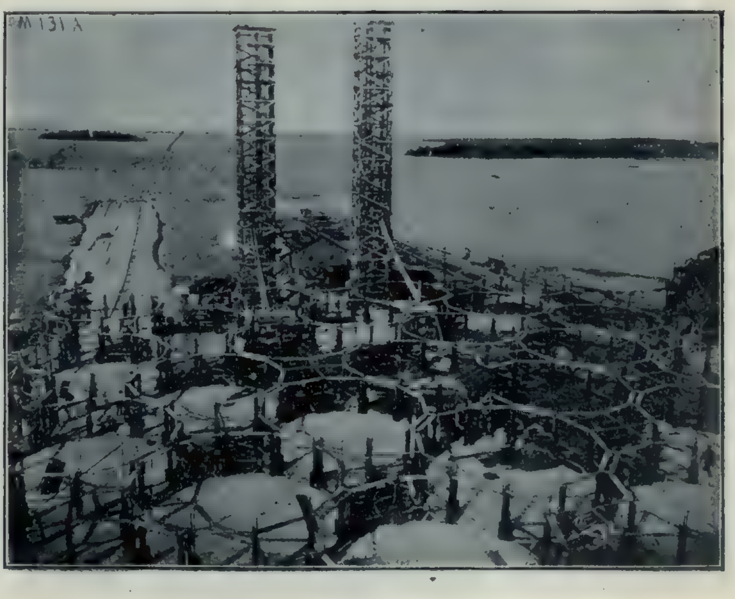


Fig. 6—Elevator construction work at Port McNicoll.

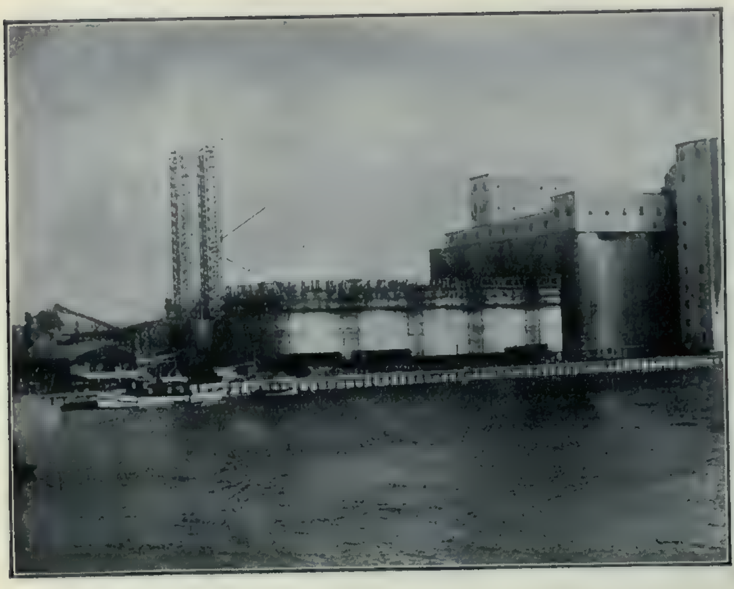


Fig 7—Port McNicoll construction. Form work in progress.

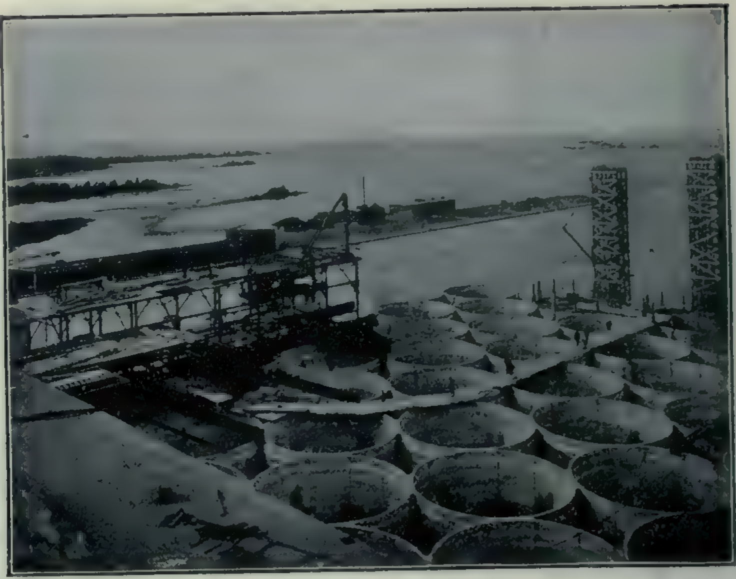


Fig. 8—Port McNicoll construction. Forms removed from bins.

be about equal to the weight of grain in a cone with a base equal to the bottom, and of a height three diameters at the base. This was arrived at by experiment, but the side pressure was not known. It was found that after a bin was filled to a height of about three times the diameter of the base, it did not matter how much more was put in, because the pressure on the bottom did not increase, and from this it was an easy matter to demonstrate that the pressures on the side were uniform for each succeeding foot up from the bottom, until near the top, but the amount of these pressures was not known.

Everyone who thought about the matter knew that it had something to do with the friction of the grain on the wall, and finally it was found that it would take two pounds, at least, to hold a pound of grain against the wall. The pressure might be more than two pounds, but it could not be anything less. Many engineers engaged in the business made more or less correct experiments to determine the pressure. An experiment with a bin about eighteen inches square, with three sides solid and one side with wooden slats was made by the author. These slats were kept apart so that each acted independently. Each slat was tested with a centre load to find how much it would take to deflect it a certain amount, the stronger of the slats were selected and put at the bottom, and each one labelled with the load it would carry for a certain deflection. It was found that the side pressure was everywhere very nearly twice the weight of the grain held against the slat, but that as soon as a small hole in the bottom was opened and the grain allowed to trickle out, the slats bent a great deal more because of the change in conditions. It was estimated that the pressure on the bin walls when the grain was in motion was about three times the weight of the grain pressing against it. This very simple rule was adopted about the year 1898, and since then elevators have been built on that assumption. Although a lot of good work has been done in the investigation of grain pressure in more recent years the author has seen no occasion for changing this rule. It figures just a little more than some of the rules employed; a little more, possibly, than Mr. Jamieson's experiments, and is just

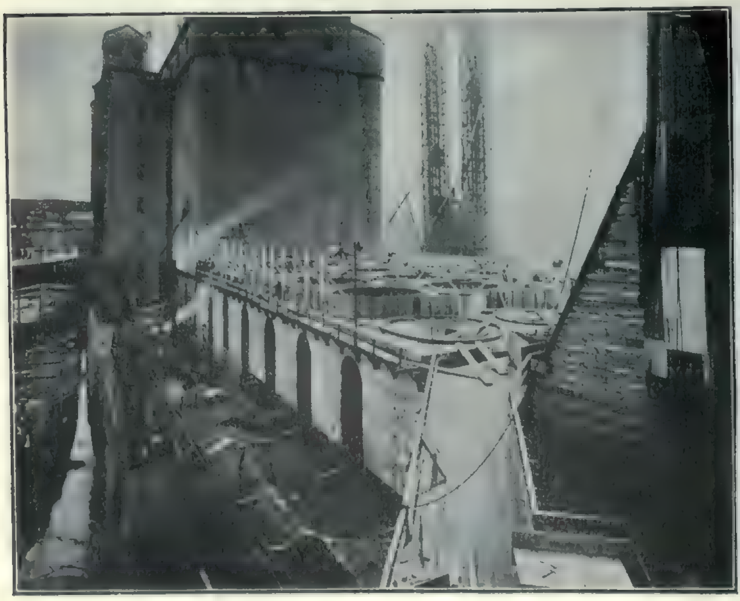


Fig. 9-Form work in progress at Elevator No. 1, Montreal harbor.

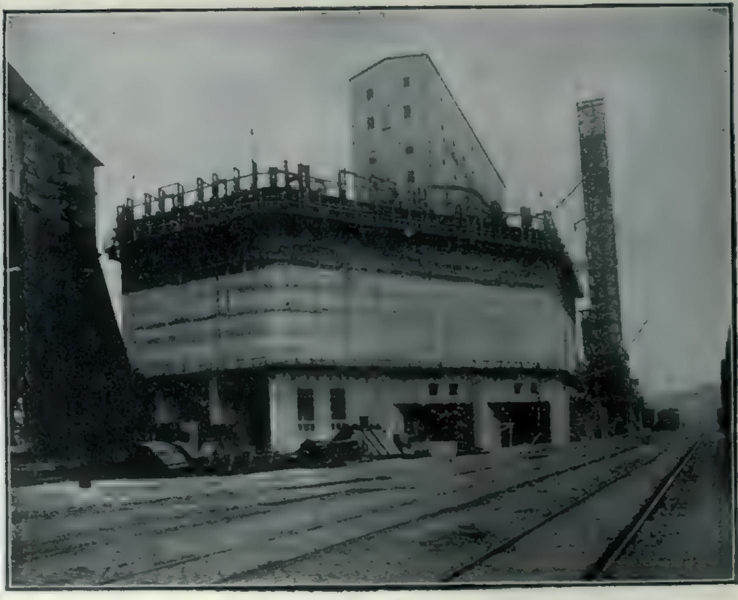


Fig. 10—Montreal harbor elevator. One week's progress on forms.

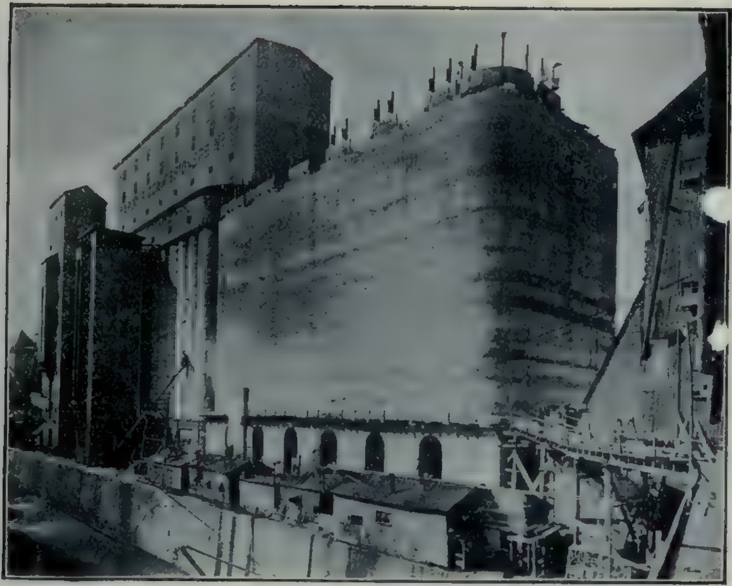


Fig. 11—Montreal harbor elevator. Forms removed from top of bins.

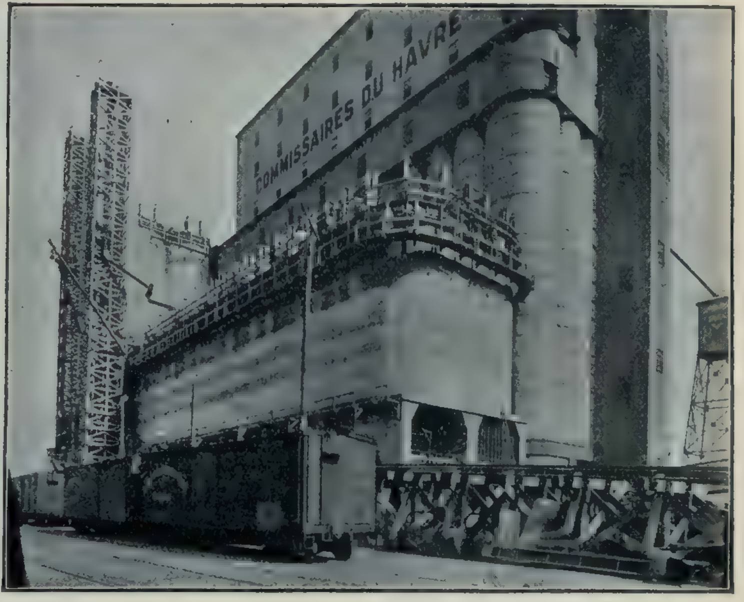


Fig. 12—Montreal harbor elevator. View of bins from land side.

a little safer. These experiments were followed with an experimental bin which was built in this city before the Windmill Point elevator was put up, and from that bin the pressures were determined.

In the experiments with the small bin with the slats on one side of it one peculiarity was especially noticed. The bin was filled up to the top, struck off level, and then a slide was opened on the bottom and a portion of the grain allowed to run out. The slats on the side bulged out, making the bin a little bigger. The grain, however, that had been taken out at the bottom could not be put in at the top without heaping. This showed that when the grain fell into the bin it packed pretty well near the bottom, and when the bottom slides opened and allowed some of the grain to flow out there was an area of grain in the immediate neighborhood of the opening less dense than the grain in other parts of the bin. With a glass side in the bin it was possible to see the grain arch over. The point where the little kernels held up the under side of the arch could be seen, and as the grain went out at the bottom the under side of the arch crumbled off. The pull of the grain on any obstruction that meets its path in the bin is quite strong. In steel elevators considerable difficulty has been experienced because the tie bars across the bins pulled out the rivets. Apparently enough rivets were figured for the strain due to the load on the edge of the bars, but the suction of grain on the side of the five-inch flat bars would pull them down, twist them over and pull the rivets off. Of course, this was not so apparent with round bars. In one case of round bars, an elevator was built with bins that were twelve feet by twenty-four feet, and about seventy feet deep, rodded in the middle. There were two openings in the bin, one in the centre of each of the twelve feet square portions of the bottom, and these rods, of course, were in a line up the middle of the bin. The builder of that elevator was apparently afraid of the suction of the grain on the rods, and in order to overcome it 6 x 6 posts were put up in the centre of the bin to support each rod so that the down pull of the grain would not break the rod. Whenever the valve at one side of these rods was opened at the bottom of the bin there was a suction of the grain

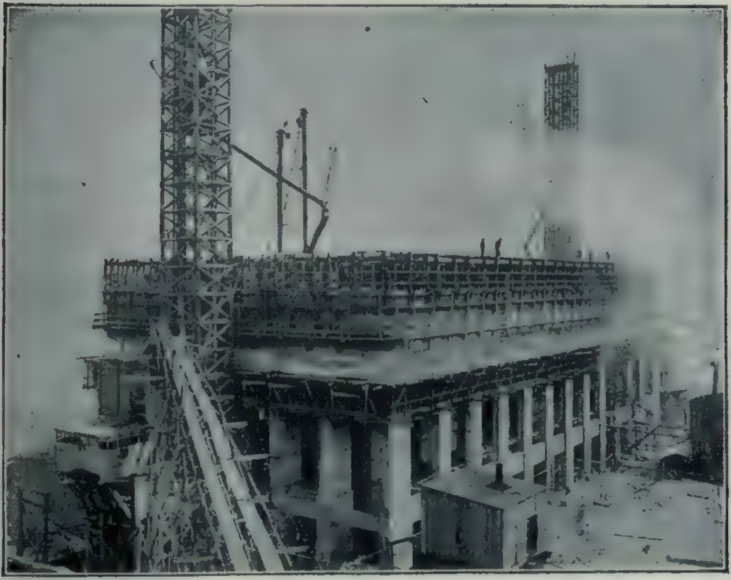


Fig. 13—Elevator construction at St. John, N. B.

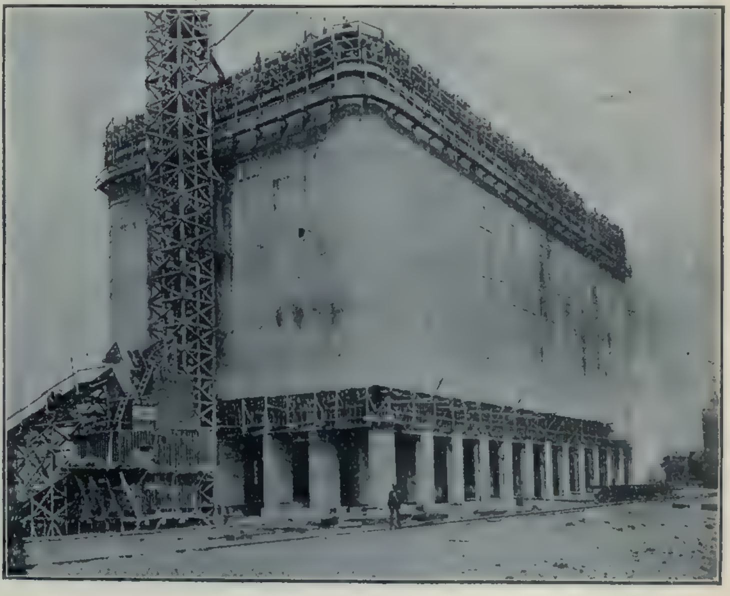
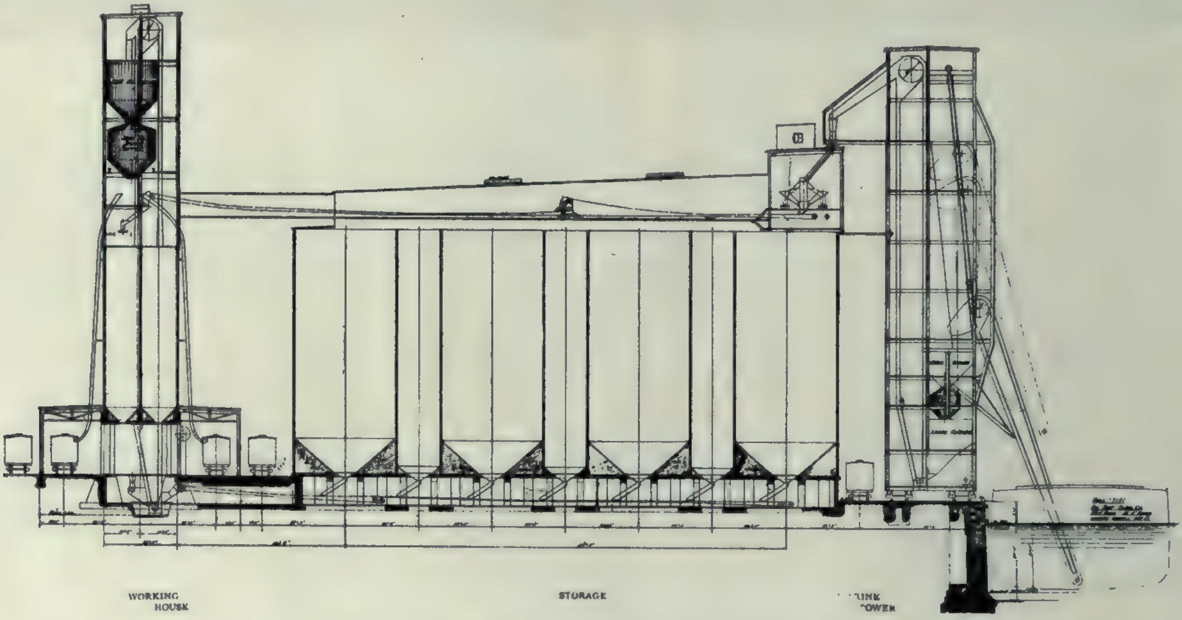


Fig. 14—The St. John work two weeks later.

sideways, and it was found that the 6 x 6 posts would not stand. The posts were, therefore, taken out and 8 x 8 posts substituted. These also did not stand the strain. The owner was advised to take the posts out and there was no more trouble. The action is very simple. When the hole in the left-hand side was opened the grain coming across pushed over the posts, and instead of the posts helping the rods they pulled them down.

The building of the bins is probably the most interesting feature in the construction of a grain elevator. It was the feature which required the most careful consideration when the change from the wooden house to the concrete elevator took place.

Figs. 3 and 4 are illustrations of the manner in which an elevator is being built at the present time in Manchester, England. The bins are of concrete, rectangular in plan, and about 70 feet deep, some kind of a shutter form being used. The reinforcing is both vertical and horizontal, and the vertical reinforcing is spaced so closely that looking at the picture it would appear almost impossible for the workmen to get from one part to another. The progress on this work is about 18 inches vertical, per week, and at this rate it will take eleven months to put up the bin walls.



General cross section, C. P. R. elevator at Victoria Harbor, Ont.

Fig. 5 illustrates how elevator building is done on this side of the water. It is a picture of the forms for some bins erected at Fort William. The bins are circular in plan, the cylinders being placed in contact with each other, and the small spaces between the cylinders being used for storage of grain. On this form a man may walk anywhere over the entire area covered by the structure, and may wheel concrete and deposit it in any of these walls directly from buggies. The moving form, about four feet deep, goes around the outside and inside of the bin walls and is held together by yokes of some kind that span the wall above the level of the form proper. A jacking device is attached to the form so that it can be lifted up as the work progresses. The concrete is poured into the form and the form moved up continuously. This part of the work may be executed in different ways. Some use a plain round rod with a jack that clamps the rod, and the form simply climbs up on the rod leaving the rod in the wall. On the forms shown in the illustration, rods threaded the entire length were used with an ordinary nut and nut holder, with means to turn the nuts so as to lift the form as the work progressed.

Fig. 6 is a view looking out over the top of the forms at Port McNicoll; the bins are thirty-three feet in diameter with walls eight inches thick.

Fig. 7 is the same work viewed from the other side of the slip, showing the forms part way up. The first section of the building is shown to the right. The second section was put up last summer. The illustration shows the arrangement for conveying the material over to two towers, from which it was spouted out to carts and distributed over the area.

Fig. 8 is a picture of the same set of bins after the forms had been removed and the steel work was being erected on top of them. These bins hold in the neighborhood of forty-eight thousand bushels of wheat each.

Fig. 9 shows some forms being erected in Montreal harbour for Elevator No. 1. These forms were run up ninety-six feet in fifteen days, about six feet four inches a day. The distance that a moving form may be raised, or the amount of a bin wall that can be built in a day, depends on a great many elements. For instance, if the building under construction is very large, the difficulty of getting a sufficient amount of material on the work in twenty-four hours is probably the controlling feature. When the building is not very large, the rapidity with which the material will set up is the controlling feature. In warm weather, with a small job, it is possible to put in over ten feet a day. This summer at Lawrenceburg, Ind., on a small building, the walls were run up ten feet five inches in twenty-four hours. That is going just a little too fast because there is danger of the concrete falling out of the forms at the bottom. Six feet can be put in with safety in warm weather, and, in cold weather, the progress must be much slower. The bottoms of the forms should be watched to see that the concrete is setting up sufficiently to sustain the load above it.

Fig. 10 is another view of the Harbour Elevator No. 1, showing the height to which the forms had been raised in just one week's work. The dark line indi-

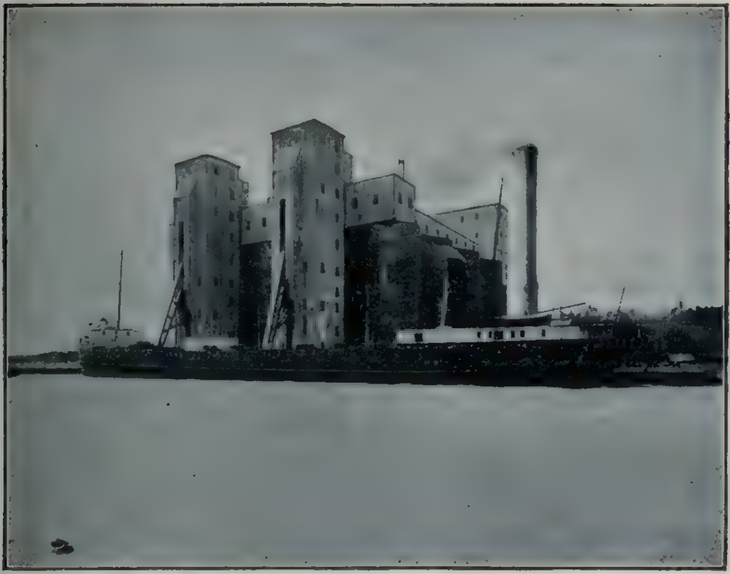


Fig. 16—An elevator at Tiffin, Ont. Note the marine towers.

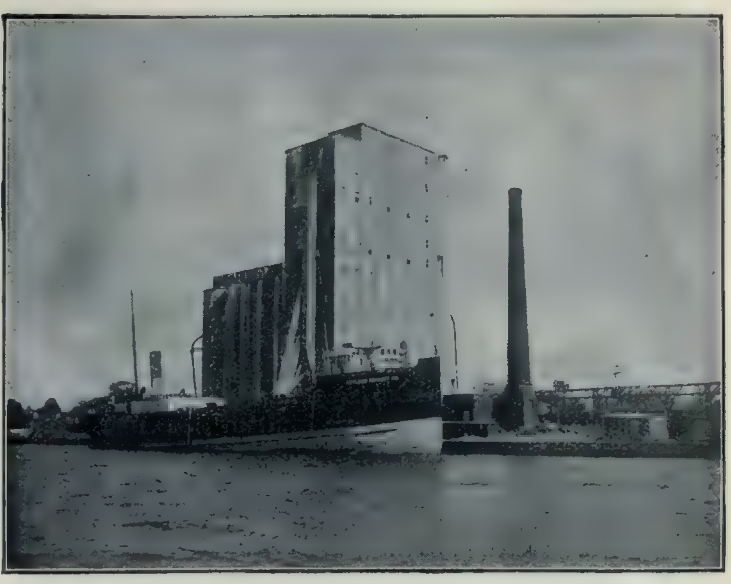


Fig. 17—Concrete elevator at Ogdensburg, N. Y.

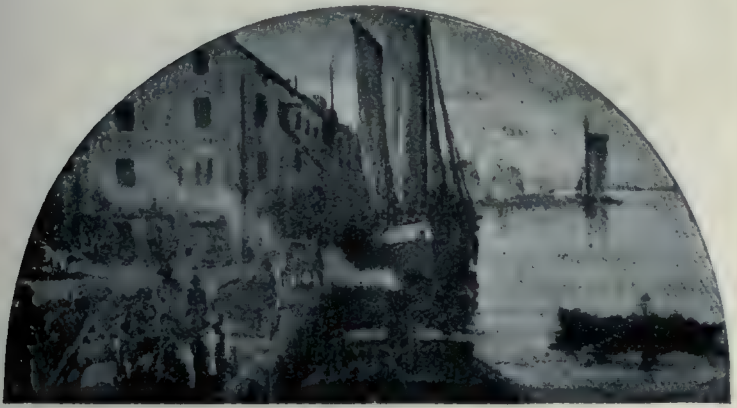


Fig. 15—Chicago's first grain elevator, built in 1838.

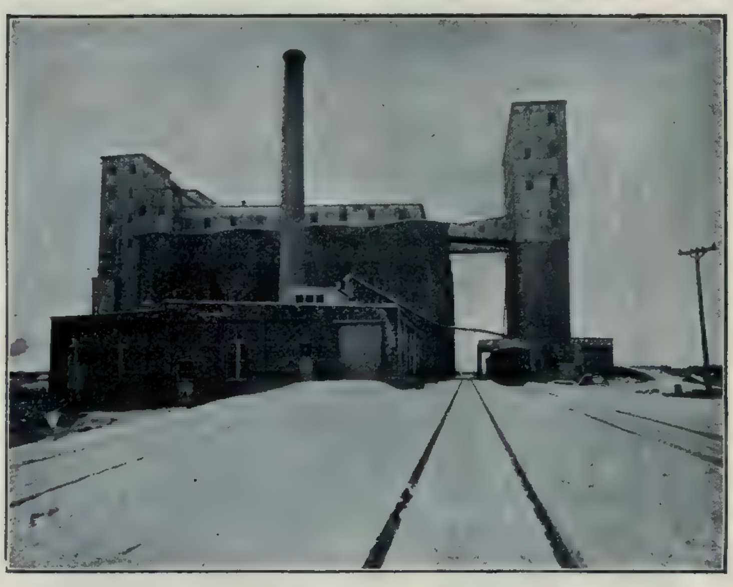


Fig. 18—Elevator building at Port McNicoll.

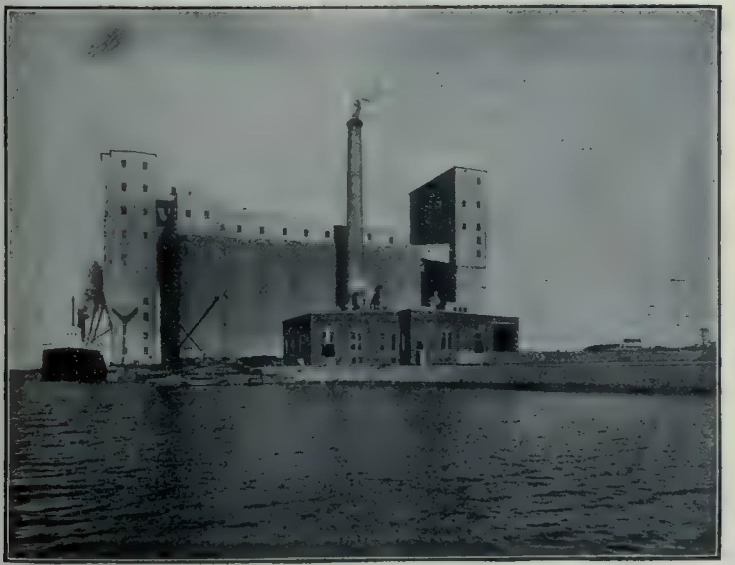


Fig. 19—Another view of the Port McNicoll building.

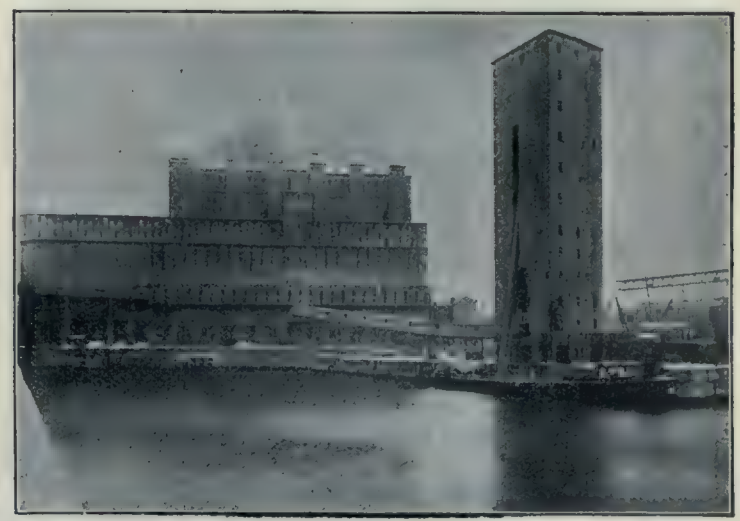


Fig. 20—Montreal Harbor Elevator No. 2. Capacity two and one-half million bushels. The largest concrete building of its kind in the world.

cates that this material was not set up very hard. It dries out on one side faster than on the other, probably depending on exposures to the sun.

Fig. 11 shows the same work two weeks later, with the forms removed from the top of the bins and about ready for the steel.

Fig. 12 is a view at the other end of Elevator No. 1, showing eighteen bins on the land side. The scaffold shown below the form is for the men to go around and point up any defects which may appear in the wall as soon as the wall is uncovered by the gradual upward movement of the forms. One of the difficulties in building in a location such as that shown in the picture is due to the restricted space and absence of any place in which to store a large amount of material so that a number of bins can be built at one time. The reason for cutting this particular work in two and building one part first and then the other was that it was impossible to get enough material on the ground to build everything at once.

Fig. 13 is another view of the same kind of building at St. John, N.B. This particular picture was taken on June 18th, four days after the moving forms were started, and two weeks later (Fig. 14) the building was seventy feet high. It went up fifty-three feet in two weeks. One of the troubles was to get enough material to keep the work going as fast as was otherwise possible.

A word should be said about the marine towers shown in Fig. 16, which is an elevator at Tiffin, Ont. These towers are 28 x 32 feet and 150 feet high. They run on two tracks and have a mechanism to propel them along the wharf. Each tower is supported by forty car wheels and weighs about 650 tons,—quite a bulky thing to move around. It is moved longitudinally in order that it may get into various hatches and holds of vessels, so that if one tower gets through its work ahead of another it can move to another hatch. One of the principal troubles with the tower is to hold it against the wind pressure, which is quite great on a structure so high. The tower is held back to the storage building by a travelling guide which is about thirty feet long. These towers are supplied, at intervals along the wharf, with various places at which to lock in case of storms, and have a propelling mechanism which will take them against a ten pound wind; if the wind is stronger than that the towers have to remain in one place. A tower of this kind is also supplied with mechanism to raise, lower and place the marine leg in any position in the hold of a boat. This marine leg is eighty feet long and weighs with its boom, thirty-one tons. Power to operate the ship and clean-up shovels is supplied from the tower, and the grain is weighed in the tower as it is received.

The first grain elevator in Chicago, built in 1838, is shown in Fig. 15. It was simply an old warehouse, with an elevator leg put in it, a belt with buckets on it, and at the top one horse-power (literally, as a horse on a treadmill furnished power) which elevated grain to the top of the building where it was spouted on to the floor. Holes were cut in the floors to let the grain fall down on to the next storey. The spouts leading out to the vessels show that grain was then carried in bulk instead of in sacks. Quite a number of old buildings were used in that way. In one case an old dwelling house in St. Louis was used to store grain. The building stood while it was filled, but when the grain was being drawn off in the spring, it collapsed.

Fig. 17 is the picture of a concrete elevator at Ogdensburg, The only peculiarity about it is that the marine tower shown on the side was built with a moving form, and put up at the same time that the bin wall was constructed. It was a pretty piece of work and very expensive.

Figs. 18 and 19 show the complete house at Victoria Harbour, Port McNicoll, including the power plant and the concrete stack. This concrete stack has no cracks in it. One was built before that had a great many cracks, the reason being that there was not enough concrete in the stack. It was erected by a stack builder who prior to making the specifications had examined a large number of stacks and found that they were all more or less cracked. The theory upon which these stacks were built was that enough steel was put in them to take the tension and enough concrete to take the compression. As a matter of fact, in building a concrete stack enough steel should be put in to take the tension if the concrete cracks, and then enough concrete to take the tension anyway. At least the tension on the combined section of the concrete and steel should be low enough to prevent the concrete from cracking. The walls of a concrete stack would, under these conditions, be twice as thick as those made by the ordinary stack builder.

Fig. 20 is a picture of Harbour Elevator No. 2, Montreal, an elevator of two and a half million bushels capacity, all concrete; in fact, the largest all concrete building in the world. It required 44,000 yards of concrete and 2,900 tons of reinforcing steel. It has an unloading capacity from cars of about 250 cars in ten hours, 40,000 bushels per hour from boats with its two marine legs, one on each side of the tower shown in the foreground, a shipping capacity of 90,000 bushels per hour to boats, and is an entirely up-to-date house. This elevator, with the Windmill Point and Harbour Commissioners No. 1 Elevator and their shipping galleries, makes Montreal the best equipped ocean grain harbour in the world. The equipment, however, is not sufficient for the demands of the port.

Quality in Concrete Mixing

THE contractor who is contemplating the purchase of a concrete mixer naturally looks for quality before buying. Mixer quality means a combination of many good things, and to have true quality a mixer must possess at least the following characteristics:

(1) It must be designed to operate according to the correct mixing principle, for perfect mixing is governed by a scientific principle, just as is every other mechanical operation.

(2) It must be well constructed; that is, good materials and good workmanship must be employed in its manufacture.

(3) It must have capacity; that is, its body must have large volume in proportion to the space it occupies; and its speed of full-volume output must be rapid.

(4) Its total output life must be long; that is, that volume of concrete which it will mix before being worn out must be large.

(5) Its delay losses must be small; that is, interruption of working time for making repairs or due to any defect of the mixer itself must be a minimum.

(6) It must be manageable; that is, all operating functions must be capable of perfect control as to time, amount, and place.—Cement World.

Cost Accounting and Its Importance on Construction Work

By Leslie H. Allen.

THE problem of cost accounting on construction work is one that has not received the amount of attention and study that its importance warrants. When we consider the vital importance to the contractor on construction work of a knowledge of the cost of his work, it is surprising to find that only a few contractors have succeeded in finding out in detail what the unit costs of their work are. Most of the big commercial enterprises make a point of figuring very carefully their cost of production, but building and engineering contractors seem content to go on in their old ways, with only a hazy idea how their work is coming out, and no definite knowledge as to the amount of profit or loss made until the job is completely finished and paid for. Mr. Sanford Thompson, in his book "Concrete Costs," asserts that "as generally practised, cost keeping is so approximate and inaccurate as to be of comparatively little value for estimating or for immediate use," and later on he states that estimates of labour costs are frequently mere guesses, because the contractor does not know with any degree of accuracy the time and cost of doing each kind of work." I venture to assert that not more than 10 per cent. of the contractors in Boston doing work on a lump-sum basis could tell within one thousand dollars what their profits or losses are on their unfinished contracts now in hand.

It is not hard to find a reason for this state of affairs. The old-time superintendent of construction was usually a mechanic who by reason of special ability had risen to the command of men and become a superintendent. These men, of whom many are still with us (and doing excellent work), are men to whom figures and costs meant very little. They relied for success on their innate common sense and their ability to drive the men under them, and although they made mistakes, some of which would have been self-evident if they had studied costs carefully, yet they did excellent work and achieved results not to be despised even in these days of scientific management, cost accounting, and complex organizations of one sort or another. Such men, however, took no interest in cost accounting, and if directed to furnish cost figures took very little care to see if they were made up rightly or not.

Another reason is that there is often a lack of definite instruction given from the office as to how costs are to be kept, and that no man who has studied the problem and knows definitely just what is wanted is in charge of the work and personally responsible for it. The timekeeper on a construction job is a very busy man. Often he has materials to order and check, and many other duties to perform, and has no time to think out the details of a cost-accounting system for himself, and he contents himself with as little work in subdivision of payrolls as his experience tells him will "get by." Then when his reports come in they are handled by clerks who do not understand them and who do not make any effort to correct them as they go through, and the cost-accounting system becomes unreliable and one is told that "it is impossible to keep accurate costs on construction work."

It is probably true that every contractor and builder has made some attempt to find out the unit costs of the work he does. Some contractors have got a system that really gives them the information they need. Many firms have a cost-keeping system which tells them approximately what their unit labour costs from week to week are, but takes no account of materials and gives them no idea as to how the whole job stands financially. Such men have no real idea as to whether their jobs are profitable or not until the bookkeeper's statement at the close of each job shows the actual profit or loss made. Many have tried to keep up a cost-keeping system, but have thrown it up owing to its difficulties and inaccuracies, and rely simply on their bookkeepers to tell them how much expense has been incurred on the job, while their eye tells them how much of the job is done. The author remembers in his earlier days being directed to visit half-completed jobs for which he had made the estimate and make a survey of same for comparison with the bookkeeper's statements, and this was the only way known by his firm at that time of comparing estimated costs with actual costs to see what profit or loss had been made, although at that time a system of reporting weekly costs was being used similar to that outlined above.

With the change of the times and the change in contractors' methods the attitude of the contractor to cost-accounting systems is changing too. The old-time superintendent is giving place to the technical graduate who is a man with engineering training accustomed to view the situation from all sides and relying on actual cost figures rather than on his own judgment to tell whether his work is efficient. Modern competition is becoming so keen and work is taken on such a small margin of profit that it is of vital importance that every item of the work be kept down to its estimated cost, and cost keeping is fast becoming a necessity to all who wish to make a profit out of contracting on construction work.

The purpose of any cost-accounting system is threefold. First, to watch the job from week to week to see if the work is being carried out economically; second, to see whether the cost is above or below that of the original estimate; and third, to furnish information for future use in estimating and in supervising work in progress. In other words, first, to determine the items of prime cost and the unit prices of these items; second, to discover what relation these bear to a predetermined selling price; third, to establish new selling prices for future work. The relative importance of these three items is in the order given.

The problem before the contractor's accountant is an entirely different one from that of the bookkeeper or the factory cost-keeper. A good deal of the dissatisfaction and incompleteness of many existing systems is because the problem has been approached from the financial point of view rather than the engineer's. I think it was Mr. R. T. Dana who was the first to insist that cost keeping was not a bookkeeper's job and could not be satisfactorily handled by the man who kept the firm's books. This is so. The bookkeeper's viewpoint is the financial one, and deals with totals and balances of cash. The cost accountant's viewpoint is an engineer's, and deals with unit costs and quantities of materials. The two cannot be satisfactorily held by one man unless he has had a thorough training both in bookkeeping and engineering lines. Such a training is rare. The primary object of the cost-keeper in a large factory or mill is to determine the selling cost of the articles, and therefore every item of expense burden incurred in carrying on the factory is prorated or apportioned to the cost of the articles produced for sale. The contractor's selling cost is determined beforehand and he is faced with the problem of so splitting up his selling cost that he has a proper appropriation for each item of expense, the very reverse of the factory's accountant's problem. It is for this reason that I have placed prime cost first as being the most important, and selling cost last as of least importance.

The estimate of cost on which a contract is taken is more like the Budget appropriation of our Government, which, having a predetermined amount of money to spend, proceeds to allot as much as is possible to each Government department in proportion to its needs, the total of such appropriations being equal to the amount of the estimate of cost.

The contractor's cost accounts, if they are to be of any use, must show not only the amount of money spent in the work, but the way in which it has been spent, and this cannot be shown if items of general expense, such as plant, watchmen, etc., are all distributed among the items of excavation or concrete. The result may be financially accurate but uninforming to the contractor. For instance, on the cost accounts on the Panama Canal, cost of plant, track, forms, and general expense, etc., all are worked out in terms of per cubic yard of concrete. This is correct from the financial viewpoint, and the result shows the cost of the concrete to the Government. But it does not tell an engineer whether the work is being done efficiently or not. He wants to know the cost of setting up and repairing the plant, the cost of handling the material, the detailed cost of form work, while general expense is meaningless to him unless he knows the details. When the cost of moving tracks, repairing plant, etc., is reported at so much per cubic yard as a subdivision of excavating cost, the cost of the operation cannot be criticised. It is very necessary that this distinction be kept in mind and that costs should be worked out from an engineer's standpoint rather than from a bookeeper's or an accountant's standpoint. The information turned out by the cost-accounting department should not only show results but should give information showing the reason why the results are so.

In the author's judgment, the cost accounting on construction work should be handled in connection with the estimating department rather than in connection with the bookkeeping department. The estimator should know best what information he requires from a job to check up the work he has estimated, and into what units the costs should be divided. He is then enabled to keep closely in touch with actual work in progress and compare with his estimate from time to time.

The method usually employed by contractors in their cost accounting is to divide up the time spent on the job under certain fixed headings, such as excavation, brickwork, mason work, concrete work, carpentry, and so on, and to make a report of the quantity of each kind of work executed, and to work out from same either daily or weekly the unit labour costs; at the close of the job, to work these up into totals and also to work up at this time the cost of all materials into units and combine them with the labour costs, giving the total cost of labour and material on each item of the work. This works well in some offices as far as it goes, and shows whether each week's work was efficient and economical. But if no account is kept of material until the job is closed, and no check is taken on quantities reported by the men on the job, and no comparison is made with the estimate, its value is not very great. In the system used by the Aberthaw Construction Company, we have added from time to time the following features which do not appear in most accounting systems. First, in addition to the weekly labour costs, the average labour cost on each item to date is figured. Second, a periodical check on the quantity report is made. Third, we use a standard mnemonic code revised to suit the requirements of each job. Fourth, an accounting of material is kept up from month to month. Fifth, an analysis of the estimate is made for comparison with the weekly costs. Sixth, a monthly balance is struck, showing profit or loss to date. Seventh, a "field sheet' is furnished to the timekeeper, which enables him to keep track more regularly and systematically of the men at work.

It is the purpose of this paper to describe the Aberthaw Company's system in detail, taking up in logical order the above points and matters incidental thereto. The present system was not invented in a day, but has been a gradual development. The cost-keeping system was installed early in the history of the company by Mr. Wason, the president of the company, who laid work out upon the usual lines adopted by other contractors as indicated above. The above additional features have been added since the beginning of 1910 in the order indicated above, and the complete system may be said to have been in working order for over two years, long enough for us properly to try it out and to know that it really gives us the information we need. In other words, the system I am about to describe is not the dream of a theorist, but something that is really practicable; that is not expensive in operation and that any contractor can use if he has but the patience to study his problem and insist on getting just the results he wants.

Although the author's firm specialises in one branch of construction work, the system is equally applicable to any other work of similar nature, whether in the line of heavy engineering or the building of modern office buildings or frame dwelling-houses.

All metal which has been bent or otherwise injured in handling or in transit should be carefully repaired before being used. Reinforcing bars must be straight and free from flaws in any degree calculated to impair their strength.

While a piece of lift machinery weighing 3,275 lbs. was being hoisted in a building at El Paso, Texas, it fell upon a reinforced concrete floor slab 5½ ins. thick. As the height of the fall was 85 ft., it is not surprising that a hole was made in the concrete, but the reinforcement remained intact and sustained the machinery at about 12 ins. below floor level. Practically no damage was done to the adjacent floor beam.

Concrete Highway Construction at Montreal

THE Canada Cement Company, Limited, have just completed at their No. 1 plant, nine miles east of the centre of Montreal, a concrete road which has some interesting features. The road was built to provide a permanent highway from the main road—Notre Dame Street—to the entrance to the plant for shipping by truck to the city.

In general, the standard specifications for concrete roads were followed. The actual construction was done by the Sicily Asphaltum Paving Company, Limited, of Montreal, under the supervision of the Canada Cement Company, Limited. The road is divided into 15 sections, the details of which are given later. In some sections eight pounds of high calcium hydrated lime were added to each bag of cement and the two thoroughly mixed before placing in the concrete mixer. In the one-course sections containing lime, the lime was used throughout the entire thickness, but in two-course sections the lime was used in the top course only.

Reinforcing consisted of two kinds—American Steel & Wire Company's No. 7 and No. 28 triangular mesh, and Clinton Electrically Welded Wire 5-in. x 9-in. mesh No. 12 wires, and 4-in. x 12-in. mesh No. 8 and No. 10 wires respectively. The reinforcing was cut into sheets 13 ft. 6 in. long, which were placed transversely 2 inches below the surface. All sections of the road are 20 feet wide—concrete 14 feet and shoulders of broken stone 3 feet. on each side. The shoulders are thoroughly compacted, and are given a transverse slope away from the concrete of 1½ in. for each foot of width. A 4-inch tile drain was placed under the north shoulder from Sta. 7 + 70 in Section 5 to Sta. 26 + 07, the mill end of the road. The bottom of the drain is 24 inches below the sub-grade and the trench re-filled with broken stone. The surface water is taken care of by a ditch along the south side of the roadway.

Concrete road at No. 1 plant, Canada Cement Company, Limited, Montreal.

The proportions used for one-course concrete were 1:1½:3. For two-course concrete the proportions for the base were 1:2½:5 and for the wearing course 1:1:1½. The sub-grade was rolled the entire width of 20 feet. The concrete is 6 inches thick at the sides and 8 inches thick at the centre for all sections. In two-course sections the wearing course has a uniform thickness of 2 inches. The crown of the roadway has a rise of two inches at the centre, the section of the surface perpendicular to the centre of the road being the arc of a circle.

The surface of the pavement was sprayed with water as soon as the concrete was sufficiently hardened to prevent pitting. It was then covered with a layer of earth at least two inches thick which was kept moist for about ten days, after which this earth covering was removed.

Joints made of two thicknesses of three-ply tarred felt, were placed approximately 30 feet apart from Sta. 0 + 00 (at Notre Dame Street) to Sta. 3 + 13 in Sections 1, 2, 3, and 4. No joints were allowed in Sections 5 to 8 and 9 to 15 inclusive. In these sections the reinforcing is continuous between successive days' work. At the end of each day's work the concrete was finished with a vertical face.

The details of the sections are as follows:

Section 1.—Length 115 feet (Sta. 0 + 00 to 1 + 15). One-course concrete with lime.

Section 2.—Length 37 feet (Sta. 1 + 15 to Sta. 1 + 52). One-course concrete.

Section 3.—Length 96 feet (Sta. 1 + 52 to Sta. 2 + 48). One-course concrete reinforced with 4-in. x 12-in. Clinton wire.

Section 4.—Length 65 feet (Sta. 2 + 48 to Sta. 3 + 13). One-course concrete reinforced with 5-in. x 9-in. Clinton wire.

Section 5.—Length 394 feet (Sta. 3 + 92 to Sta. 7 + 86). Two-course concrete reinforced with 5-in. x 9-in. Clinton wire.

Section 6.—Length 93 feet (Sta. 7 + 86 to Sta. 8 + 79). Two-course concrete reinforced with No. 7 triangular mesh.

Section 7.—Length 237 feet (Sta. 8 + 79 to St. 11 + 16). Two-course concrete with lime reinforced with No. 7 Triangular mesh.

Section 8.—Length 253 feet (Sta. 11 + 16 to Sta. 13 + 69). Two-course concrete with lime reinforced with 5-in. x 9-in. Clinton wire.

Section 9.—Length 19 feet (Sta. 13 + 87 to Cta. 14 + 06). One-course concrete reinforced with No. 7 Triangular mesh.

Section 10.—Length 226 feet (Sta. 14 + 06 to Sta. 16 + 32). One-course concrete reinforced with 4-in. x 12-in. Clinton wire.

Section 11.—Length 245 feet (Sta. 16 + 32 to Sta.

18 + 77). One-course concrete reinforced with No. 28 Triangular mesh.

Section 12.—Length 118 feet (Sta. 18 + 77 to Sta. 19 + 95). One-course concrete reinforced with No. 8 Triangular mesh.

Section 13.—Length 122 feet (Sta. 19 + 95 to Sta. 21 + 17). One-course concrete with lime reinforced with No. 7 Triangular mesh.

Section 14.—Length 244 feet (Sta. 21 + 17 to Sta. 23 + 61). One-course concrete with lime reinforced with No. 28 Triangular mesh.

Section 15.—Length 246 feet (Sta. 23 + 61 to Sta. 26 + 07). One-course concrete with lime reinforced with 4-in. x 12-in. Clinton wire.

Some Waterworks Engineering Mistakes*

IN 1895 it became necessary for the Peoria Water Works Company, of which the writer was then Engineer and Superintendent, to increase its water supply, and to do so rapidly. This plant included, among other items, an open well, 11 ft. inside diam. In the construction of this wall the earth was first excavated as far as the ground water would permit, and a cast iron well shoe, built of circular segments, was bolted together, and on top of this well shoe were bolted segments of oak designed to widen the shoe and to serve as a foundation for the brick masonry wall of the well. Excavation was started inside of the well shoe, the masonry wall being built up on top of these wooden segments as the well sunk. It was the intention to sink this well to bed rock, seal the bottom with concrete so as to make a watertight pit, and then drive out push wells through apertures in the wall.

The writer, however, made the mistake of pumping from the inside of this well, part of the material being removed by the pumps and part by buckets which were filled by men standing on the bottom. The well sank rapidly from 2 to 3 ft. a day until within 12 ft. of bed rock, when its progress was suddenly diminished and all efforts failed to get more than 4 ft. further. It was found that at about 8 ft. from bed rock the sand ran in under the shoe as fast as it could be removed.

An effort was then made to sink a steel ring 10 ft. in diameter by 5 ft. high by ½ in. thick on the inside of the well in the hope that this could be sent down to bed rock; but after much time had been lost in trying to keep ahead of the incoming sand, the attempt was abandoned. Oak wedges were then driven so as to close solidly the space between the ring and the wall of the well, and four 6-in. driven wells were sunk to bed rock. Four 6-in. push wells were also driven out through holes in the wall of the well, and all eight of these 6-in. wells were connected up to the centrifugal pumps and the plant was finally put in operation. It has been operated successfully, whenever required, during the past 19 years.

The reason why it was impossible to sink this well any further was that as the well approached the bed rock, the area of the belt of water bearing sand through which the water had to pass in order to reach the pump, was constantly growing less. At the same time the rate of pumping was constantly increasing. Consequently, when the point was reached at which the velocity of the inrushing water became so great that it dragged in the sand, this sand simply continued to run in as fast as it was removed, and the well naturally could sink no further.

On looking back at the work, this explanation of the trouble seems so simple and natural that the writer has wondered many times why he did not foresee the difficulty; but he has since seen the same mistake made so often by others that he feels encouraged to hope that this description of his own experience may prevent someone else from going wrong in the same direction. In his own practice, the lesson has been of much service, for it has led to the construction of a number of wells, in the design of which special attention was paid to the matter of preventing the inflow of sand, not only during the process of sinking the well, but also after the well has been finished and put in operation.

The particular well first described could have been sunk to bed rock at much less cost, either by the pneumatic process, or by excavating from the inside with orange peel bucket without pumping, or by sinking other wells outside of the large well and pumping from these to lower the water in the large well. As the sand was removed, the well would have sunk, provided the weight of the well were sufficient to overcome the skin friction. No more sand would have run into the well because of the fact that the water would have had no velocity to cause the sand to flow.

This mistake of the writer was at the time an expensive one for his client; but he has the satisfaction of knowing that the extra cost of this well was saved many times thereafter in other wells sunk in better fashion for the same client.

The writer made another mistake in connection with this same piece of work. The water furnished by the supplemental well was brought down by gravity to the main well, some 3,300 ft. away. For conveying this water, a 24-in. vitrified tile pipe was built. It was hoped that this tile pipe would cost much less than a cast iron pipe, and it was believed that the tile pipe could be made practically watertight. Tests of the watertightness of this pipe were described in a paper read before the Illinois Society of Engineers and Surveyors, in January, 1896.

The attempt to make the pipe practically tight was successful, but the expense was so great that the writer can now see that he should have made this pipe of cast iron instead of tile, for much of the pipe had to be laid in quicksand, and where a great deal of groundwater had to be taken care of, making it very difficult and expensive to make full cement joints in the tile, and to hold the pipe and the joint in place until the cement had set. Under these conditions, cast iron pipe would have actually cost less, laid in place, than the tile pipe.

Tile pipe has since been so often used for watertight work instead of cast iron, and so often with disappointing results, that it is hoped that a recital of the foregoing mistake may prove of service to others.

A third mistake entered into the design of a small water works, built about 20 years ago, and the writer's first complete water works installation.

This plant included an elevated tower and steel tank of about 60,000 gals. capacity, and for every part of that structure detailed working drawings were prepared. With the desire for originality too often displayed by young men, inventors, and others lacking the wisdom of practical experience, considerable pains were taken to design connections which were novel. It is safe to say that the like of some of these connections has never been seen in any other structure, before or since.

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* By D. H. Maury, in Engineering and Contracting.

The working out of all of these details not only multiplied the time required for the design of the structure by three or four, but the novelty of the connections also added several hundred dollars to the contract price, for the bidders could not use their standard shop connections, but were compelled to figure on the writer's more expensive and less practical designs.

The tank still stands, and a recent inspection showed it to be in first-class condition. The total compensation received by the writer for his services in connection with this early job was so small that his conscience troubles him somewhat less than it otherwise would; but whenever he passes that way he views that tank from the train window with mingled emotions.

The lesson to be learned from this last mistake is that no engineer, if he has his client's interests at heart, can afford to overlook the contractor's viewpoint when he prepares his specifications.

Contractors must be expert in the practical details of construction, and especially in cheapening construction costs, or they cannot continue in business. If the young engineer wishes to learn more about these matters than he has ever learned before in the same length of time, let him, after he has prepared a rough draft of his plans and specifications, discuss these with a few of the more trustworthy and experienced contractors who are likely to bid on the work, and he will be astonished to find how many changes he can make to his client's advantage, without in any way impairing the design of the work or the validity of the contract.

If the young man will then not let his exalted ideas of his dignity as an engineer prevent him from accepting suggestions of the contractors, he will show that he is worthy to receive much of the success which is almost sure to crown his future efforts.

The Engineer and the Contractor—Their Relation on the Job

THE engineer or architect is able to plan great structures and large engineering schemes, but when it comes to the erection of these structures or the methods adopted in carrying out these engineering feats to successful conclusion, this work usually devolves upon the contractor.

The contractor occupies a peculiar position in that, to be successful, he has to be possessed of a temperament and faculties not required in the average profession. I mean that the successful contractor meets and has to contend with, more obstacles in his work, than falls to the lot of the average business man or merchant, and in addition he has to be able to manage and direct his office affairs and the work of his employees in such a way that for every dollar spent on his work he hopes to receive more than one hundred cents in return.

The engineer has a great many advantages in planning a great enterprise over that enjoyed by the contractor; usually he is not limited in the time taken in drawing his plans and specifications, and has ample opportunity to investigate all conditions and make researches prior to the time when bids are called for, but the time usually allotted to the contractor for preparation of this bid is usually very short, and often a sufficient period is not allowed him for investigation of conditions, etc., source of supply of labor and material, and other important considerations which go to make up the bids prior to the opening of the same.

It has been said, and truthfully so, that a successful contractor must have three qualifications, first, Faith; second, Hope; and third, Nerve, and of these three virtues (if they may be so termed), it seems to me the latter is the most important.

First, contractors as a general rule usually know the men at the head of all large engineering schemes, upon which they bid and have faith in their judgment, and accept without question their plans and specifications as being correct, and the result of months and probably years of study, and rely in a great measure upon their judgment.

Second, they hope in event of securing a contract, to be favored with such conditions when the work is under way, as will enable them to make money legitimately, because you will find that the average contractor doing business to-day, is honest, and he takes a certain amount of pride in his work (although in this, as in all cases, there are exceptions to the general rule), and he hopes when certain conditions and questions arise, during the progress of the work, and the matter under discussion put up to the Chief Engineer or other official in authority, that he will be big and broad enough to look at the situation from the contractor's standpoint, as well as from the viewpoint of the municipality or corporation by whom he is employed.

Third, to undertake large contract work requires considerable nerve, because usually if conditions are favorable and the prices at which the contract has been secured are reasonable, and the specifications liberally construed by fairminded engineers the contractor sometimes makes money, but ofttimes when unforeseen conditions arise during the progress of the work, materials and labor advance, extremely rigid and arbitrary interpretations are given to the specifications, impractical and unreasonable inspectors placed on the work, and various other obstructions put in the contractor's way (sometimes by those directly interested in the contract, and at other times by disinterested parties), it requires considerable nerve on the part of any man to continue the business of contracting in order to make a living.

Practically all recent works of great magnitude have been let by contract, with one exception, that being the Panama Canal, which is being built by the Government, under the supervision of army engineers who had practically an unlimited amount of money at their disposal, and who were not hindered in any way in the expenditure thereof; their motto being, "Build the Canal, build it well, and at any cost."

Great works like the increased water supply for New York City, the New York Barge Canal, the reclaiming of millions of acres of land in the west, the improvement of our rivers and harbors, and even down to our own local improvement, such as the water supply, the building of our sewers, paving of the streets, covering of the falls, building of the docks, extensions of parks, improvement in terminal facilities of the various railroads leading into the city, the improvement of our State highway system, erection of municipal buildings, etc., have all been let by contract, for the reason, no doubt, that those in authority recognize that where possible, it is much better to have the work done by this method than under the day labor system.

The work is done as well under the contract system as if it is performed by day's work, and ofttimes better, because on day labor work done by a State, municipality or corporation, usually there are no rigid specifications in effect and practically no inspections (except when the engineer happens to be on the work) and many things are done, which would not be tolerated for a moment if the work was being done under contract; furthermore, the engineer on contract work has less worry (this being shifted to the contractor's shoulders), and the last, but not least reason is that it is almost universally conceded that work done by contract is done far cheaper than if performed by the day labor method.

A prominent engineer once told me that "specifications were only made for rouges and thieves, that honest men did not need any specifications"; he meant this, however, to be interpreted in a broad way.

I do not fully agree with him in his statement, because I believe that short specifications clearly written and impartially enforced are a benefit to both the municipality or corporation and the contractor.

The clauses in a set of specifications as written by the average engineer are not always clear and intelligible to the average contractor, and anyone who engages in contracting work now, if he wants to be "up-to-date" should take a course in law also, so as to be able to reason out the intent of some engineers who write specifications, because some specifications of to-day if literally construed as written, could place an average contractor in receivers' hands in a short time, unless he had an unlimited amount of money at his disposal.

Take the usual set of specifications as issued to-day for public work to reputable attorneys and ask them to give you an unbiased opinion of its contents and ninety-nine out of one hundred will tell you that you would be foolish to sign a contract with such clauses incorporated therein, because it is so written to provide all the safeguards possible for the municipality and to place the responsibility for everything that may happen, even including the acts of Providence upon the contractor.

In other words, they bind the contractor hand, foot, body and soul, because some specifications have almost every possibility and condition between the heaven and earth, and even into the depths of the same covered by a clause which they can point out, which covers the disputed point when questions arise, but contractors must live, and some in their eagerness to secure work would sign any contract and specifications no matter how definite or unreasonable it was.

To my way of thinking, it is a mistake to make specifications too lengthy, but some engineers seem to think that it is absolutely necessary to have a large volume of directions written for the contractors' guidance, even though the job is a very small one. They write so much in fact, that their requirements overlap, that is the clauses contradict themselves, and in one part of the book you will find certain clauses, and by carefully reading subsequent paragraphs, you will be left in doubt as to the real intent and meaning of the one who wrote the specifications and as to how they will be enforced.

If the specifications were short and clear, that is, expressed in plain everyday language, which neither the engineer or the contractor could take advantage of (in other words the avoidance of double meaning clauses), many of the disputes which now constantly arise would be prevented.

When a dispute does arise on work, the interpretation of the particular clause in question, is usually put up to the engineer in charge of that particular section or piece work for decision, and this is where a young engineer should be given some authority.

If enough confidence is placed in a man to select him as the pilot of a particular piece of work, enough trust and authority should be placed in him to construe disputed clauses liberally when the occasion arises, and he should be given the right to settle minor questions that arise, and not be troubling his Chief with every little matter of detail, and only in case that he and the contractor cannot agree, should the question be carried to the Chief Engineer.

In ninety-nine cases out of one hundred minor disputes such as arise on contract work can be reasonably and promptly settled if all parties will meet with a feeling of friendliness and confidence, but the average young engineer knowing that he has the book of specifications to rely upon, and that they are his doctrine, and the further fact that he is in authority in so far as that particular piece of work is concerned, ofttimes looks at the clauses under discussion from a very narrow point of view, and if an appeal should be taken from his decision and carried to the Chief Engineer, ofttimes he considers it a personal reaction upon his professional ability, and although the decision of the Chief Engineer may sustain him, there is always a feeling of coolness between him and the contractor.

Whereas on the other hand if the decision of the Chief Engineer should be adverse to the younger engineer and contrary to his views already reported to his Chief and in favor of the contractor, usually he feels that a personal insult has been inflicted on him and his professional ability questioned, and I have heard of instances where the engineer resolved to "get even" and, holding the master key he sometimes is in a position to take advantage of the other, because cooperation is the key to success in all great works.

Engineers and contractors gain their experience from years of hard work; text books do not contain all the rudiments of any profession, these are secured by personal efforts, hard knocks and practical experience and a young engineer at the completion of his required course in a university is not as fully qualified to pass on all questions as one who has had years of experience, although the technical education of the latter may be somewhat limited when compared with that of the former.

Contractors usually get their experience by hard work, and ofttimes at great expense, and some reliance should be put in their judgment also; in other words, some little credit should be given a contractor who has had years of experience, for knowing a little of the work he undertakes and the best method of conducting it, because, as before stated, a contractor to be successful must adapt himself to all conditions; must have such a personality as will enable him to please and work with the engineers and at the same time look out for himself from a financial point of view, if he is to be successful.

It is sufficient to say, in conclusion; that an engineer should rely somewhat on the contractor, "give him some credit for his experience, etc.," and the same confidence should be put by the contractor in the engineer, and if they are of such temperament that they can work in harmony, disputes will not arise. When they do, they can be quickly and amicably adjusted and leave no ill feeling at their conclusion and success will be the result of their efforts—Engineering News.

The Preparation of Architectural Drawings

Some Pertinent Suggestions Regarding a Subject of Special Value to Those Engaged in the Building Business

TO those actually engaged in the building trades, more especially to the student who is studying construction in any or all its various branches, the ability to correctly read architect's drawings is of the utmost importance. In order, however, that drawings may be readily understood it is essential that they be properly and accurately prepared and in a manner wherein a recognized system of lettering, figuring and coloring has been adopted. In these few hints on the reading of architectural drawings, says a writer in a late issue of the London Building World, it is purposed to present brief points with regard to their preparation which will be appreciated by readers who are compelled to make working drawings from sketches which are in themselves incomplete. When dealing with a set of drawings it must be remembered that it is absolutely necessary to take plans, sections and elevations together as forming one scheme or idea, for what is perhaps only imperfectly expressed upon one drawing may sometimes be made quite clear on another. Should a recess be indicated on the plan it is obvious that unless a section or elevation of this detail be studied the type and the method of finish at the head cannot be ascertained, and this same principle applies throughout.

Usual Method of Procedure

The usual method employed in all offices is to prepare firstly the complete plans, sections and elevations of the whole scheme to a scale of 8 ft. to 1 in., from the approved sketch designs, and then any particular feature is detailed to a larger scale, say 2 ft. to 1 in. Subsequently full-size details are prepared of the various mouldings and features as necessary, and each detail drawing must be followed in preference to the smaller scale drawing originally prepared. Of course, it is quite usual in many cases to detail certain features at an early period to assist in the more accurate preparation of the small scale drawings. But these are merely preliminary details, and in many instances they are redrawn and properly finished up when required at a later date. Figured dimensions must always be followed in preference to dimensions scaled from a drawing, and many mistakes would be avoided in the execution of works if draftsmen would only insert more figured dimensions, as there is often great difficulty in getting drawings absolutely true to a scale when working on such materials as tracing-linen and paper, which are much affected by the variations of the atmosphere. Sizes, unless otherwise stated, are those to the face of the rough work. For instance, a measurement shown between two brick walls indicates the face of the brickwork and not the face of the plaster or other finish that may be applied. Centre lines should always be worked from, whether in preparing or reading a drawing, and by this method the job will be greatly facilitated. In outlining a roof truss the student will find it much easier if the centre lines of all the members are drawn in the first instance, and the sizes are then scaled off on either side, and in addition he will be sure of getting all the members so disposed in relation to each other that the loads will be transmitted in a perfect manner.

Working Drawings are Colored

Architectural working drawings are invariably colored, and a certain amount of system prevails with regard to the colors used for each particular material, but slight variations are made by different offices, not, however, difficult to follow when a little experience has been gained. On the plans the flooring materials are indicated by light washes, wood being shown a light brown or yellow; cement, a pale gray; tiles, light pink; marble, light green; stone, very pale blue, and granolithic, a pale mauve. Patent flooring materials are indicated by a light wash approximating to the color of the real article.

On roof plans, tiles are shown in various shades of red; asphalt is indicated by a dull brown; slates by blue or green washes; and lead by a color as nearly as possible resembling that material. It is a common practice in coloring to indicate only those materials which are actually cut by the section line, but where the surfaces in elevation are treated, light washes are applied similar to those employed on the plans, while plaster is indicated by a light green or gray.

How Materials are Indicated in Sectional Drawings

With the materials that are actually cut through by the line of section, the colors employed are invariably of a darker nature than those above mentioned, and the following are the tints generally used: Brickwork, dark red; stonework, dark blue; woodwork, dark brown; concrete, gray or fairly dark mauve; plaster, dark green; iron and steelwork, Prussian blue.

For elevation work the colors adopted are frequently selected to give good effect to the drawing, while at the same time indicating the nature of the material. Brickwork is expressed with many shades of red, one of the most successful being an orange-red, which does not entirely lose its bright effect when dry, and a little gamboge added to the color when mixed will give this result. Gauged work is usually shown by a shade of scarlet. Woodwork in elevation is usually colored a light brown (made with burnt sienna and sepia) when wrought, and a light yellow when not wrought, but frequently greens of various shades are used for effect.

Roughcast is shown in a pale yellow, or left white, and a little light shadow color is touched on in places to relieve the monotony. Stonework colors are influenced by the kind of stone indicated, the most general color being a light yellow, but such a stone as red Mansfield would be shown a dull red to distinguish same from any other stone, while granite would be shown in various shades of gray or red. Iron and steel are colored a light Prussian blue, and leadwork in a similar manner to that on plan.

Slates are shown by blue, green or gray, and tiles by a cherry-red or any shade which is in sufficient contrast to the red employed for the brickwork if the two materials appear on the same drawing. Glass is usually shown by blue or green, but a great variety of colors are used to show this material. For shading an elevation drawing a very good color can be obtained by using crimson lake and cobalt blue mixed in the correct proportions, and it must be borne in mind that atmospheric effect can only be obtained with the use of blue in some shade or other. In coloring plans and sections a very good effect is obtained if a little lampblack be mixed with every color that is used, as it has the advantage of toning them all down and making them harmonize more completely.

Black and White Work

For black and white work, where colors cannot be used to indicate the different materials employed, they are expressed when in section by means of hatching, which varies with each material, and the method is extensively used. Brickwork can be recognized by simple straight lines, placed fairly close together, and drawn at an angle of 45 deg. with the horizontal plane. Stonework is indicated by a similar method, but every alternate line is replaced by a dotted one. Woodwork is grained to imitate the annular rings. Lead is shown by lines drawn closely together at 45 deg., crossing each other at right angles, while steel is shown by a hatching of dotted lines. Concrete is expressed by small irregular shapes, intended to represent the pieces composing the aggregate, and plaster is indicated by a filling of small dots. Another kind of hatching is that of drawing lines at an angle of 45 deg., making alternate lines, thick and thin, and this method is frequently used to show wrought iron.

The Plan as a Horizontal Section of the Building

In reading the plan of a building, remember that it is really a horizontal section taken at any height required to express all the principal walls, partitions, stairs, doors, windows and fireplaces. Details which are above the line of section are frequently dotted and this method is applied to all diagrams, whether plans or sections, to show some position or form which could not actually be seen on the drawing, but which bears some definite relation to the features which are really seen. When staircases are indicated the lines on plan show the riser face, but do not include the nosing to the tread, if there be one and the width, if figured, means that which is between the wall and inside of outer string; or if free of all walls, then the distance between the two strings in the clear. Doors and windows, unless otherwise stated, are shown between the rough work, but frequently the doors are figured in the clear. Before reading a section it is advisable to look carefully at the line on which it is taken, and this will be given on the plan or plans. The direction in which the view is taken can also be ascertained by turning the plan, so that the letters or numbers indicating the section line are upright and read correctly. The heights on a section should always be figured from floor level to floor level, and not to the ceiling line, except in special cases. Sections should always be taken at points where the principal feature can be shown, such as the staircases; and it is advisable to show them taken through different parts of the building in preference to crowding detail by dotted lines.

Use of Isometric Projection

Isometric projection is a very useful method for detailing constructional work, and is much used in good-class work, where joints and similar details have to be shown. It consists of drawing all the horizontal lines of a flat diagram at an angle of 30 deg. with the horizontal plane, while the vertical lines are drawn at right angles to the same plane, and this results in a diagram which, unlike a perspective, shows the different faces of an object as they really are, and not as they would appear to the eye. Thus they can be scaled from, and all measurements are taken either vertically or on the angle of 30 deg. and none horizontally. The architect is called upon to read steelwork drawings where the steel-framed type of building is employed, and in large structures it becomes absolutely necessary for him to see that the framing is designed in such a manner that the desired architectural treatment can be obtained, while good construction is maintained.

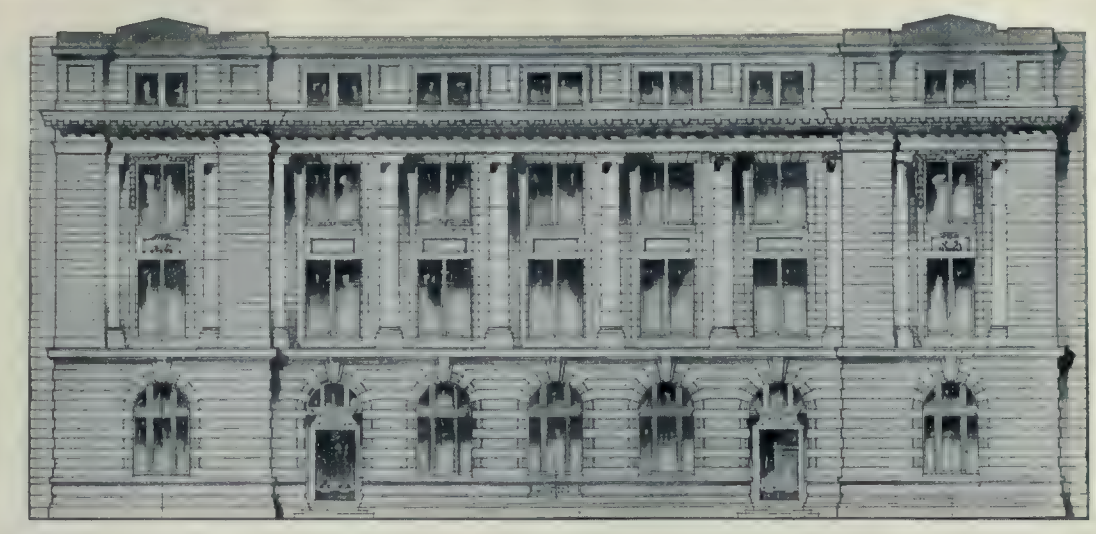
Drawings Prepared from Architects' Sketches

The majority of the drawings are prepared from the architect's sketches, and then revised to suit any alterations that may be made when the final ones are prepared. The steelwork is usually indicated by firm lines on the plan of the floor, at which level it occurs; that is, the steelwork over the ground floor and at the first floor level would be shown on the first floor plan of the building. Occasionally it is shown by dotted lines on the floor plan over which it occurs, so that the steelwork over the ground floor would be shown by dotted lines on the ground floor plan, the stanchions and supports only being indicated by solid lines on this drawing. The lines shown, of course, always indicate the centre lines of the girders and joists, and all dimensions, sizes and weights are indicated by figures, and not necessarily drawn absolutely to scale.

In reading drawings which are descriptive of the orders of architecture, students must remember that all the parts are proportioned to the diameter of the column, and therefore a scale is constructed which is composed of modules and parts, one module being equal to half the diameter of the column. Each module is divided up into thirty equal divisions, called parts, and from this scale the whole order composed of column and entablature is drawn.

The St. John, N.B., Board of Trade reports a number of enquiries from United States manufacturers looking for industrial opportunities. The opinion is expressed that our competitors on the other side of the border are already reaching out for some of the Canadian business formerly carried by Germany. In regard to the local situation, generally, it is said that public works are being pushed forward actively and that private enterprise is supplementing public effort.

Soupy concrete should be used for thin walls, but not so wet that the mortar is watery. The concrete should be puddled rather than rammed, the object being to prevent stones from collecting in any one place, and causing noticeable voids on the surface.



New Post Office at St. John, N. B.

The front elevation of the new post office at St. John, N.B., reproduced herewith, was furnished this journal by Mr. David Ewart, Chief Architect, Department of Public Works, Ottawa. From time to time we have published progress reports on this work, which is now nearing completion. The general contract was awarded in February, 1913, to Messrs. Rhodes, Curry Company, Limited, Amherst, N.S. The building is two storeys high, 200 ft. by 160 ft. in dimensions, of artificial stone construction. Mr. G. E. Fairweather, St. John, N.B., is the architect. The estimated total cost is $500,000.

Painting Concrete and Cement Surfaces

IT must be understood that ordinary linseed oil paints cannot be applied with success directly to cement or concrete surfaces on account of the alkaline lime present in the cement. The action of this alkali is to burn up or destroy the oil, causing rapid fading of colored paints, and chalking and scaling off of the material. Therefore, it is necessary, if a linseed of paint is to be used, that the surface be first thoroughly saturated with a neutralizing wash that will destroy the alkali action. The most approved method is to use a solution of zinc sulphate, made by dissolving sulphate of zinc crystals in water in the proportion of 3 lbs. to a gallon of water.

A cement surface treated with this wash and allowed to dry can then be painted with any high-grade linseed oil paint without danger from alkaline action, and with the assurance that results will be lasting, as if applied to a wood surface.

Many manufacturers now put out cement paints in liquid form, ready for use, in white and all shades; the vehicle used in these paints being alkali proof and therefore requiring no treatment of the surface before the paint is applied. Paints of this nature are being used extensively on cement and concrete construction with the very best of results, and can be obtained at a very reasonable price.

Water Color Paints

"Water color paints" should not be used for exterior cement coating, as they do not form a waterproof coating (one of the most important requirements of a cement paint) and offer no protection from deteriorating influences.

For interior cement surfaces no better material can be employed in the way of paint than an approved flat wall paint. Most of the leading brands of flat wall paint being of an alkali proof nature, and where a gloss finish is desired any ordinary gloss paint or enamel may be applied over one or two coats of the flat paint.

All new laid cement surfaces, either exterior or interior, should be allowed to become thoroughly dried out and hard before painting, and the best results have been obtained where the work has stood not less than a month before paint was applied. If the surface is dry and the paint right, it will penetrate freely on the first coat, filling the pores and rendering the pealing impossible, but this would not be the case if applied over a damp surface.

Exterior cement paints should dry to a flat or semi-flat finish in order to carry out the stone or cement effect. Nothing looks more out of place than a full gloss paint applied to exterior cement surfaces.

Cement construction, especially of a lighter type as applied to residence work, is subject to very rapid deterioration unless protected and made waterproof by the application of a suitable paint, and while in the early history of cement construction little attention was paid to the matter, owing probably to the fact that cement work at that period was confined to rough, heavy construction, such as factories, warehouses, etc., at the present time all architects and builders recognize the fact that, aside from the embellishment and decorative feature whereby the cold, unfinished appearance of cement construction is made attractive and pleasing to the eye, the protective and waterproof feature is of great importance. It is being plainly demonstrated in many cases where cement-made houses have remained long unpainted, that exposed parts become watersoaked by afterwards freezing, and burst the bond, causing cracking and crumbling of the construction and, therefore, with the increasing use of cement construction, we may expect a greatly increased demand for the painting of these surfaces.

Painting of Cement Floors

The painting of cement floors, especially in factories, warehouses, stores and public buildings, is a necessity in order to prevent the constant powdering of the surfaces from the wear, with consequent damage and annoyance from contact with this lime dust. For cement floors, the same as for other cement surfaces, the paint must be of an alkali proof nature, but quick drying with a good gloss, and must produce a tough, elastic waterproof surface.

Many of the ready prepared cement floor paints, the quick drying vehicle of which is largely China wood oil, have been found to give excellent results, and I would recommend their use by the master painter, until such time as a more complete knowledge of the requirements in mixing of this material can be obtained. There is no doubt that, for some time to come, the master painter will be feeling his way, step by step, in his new realm of modern surface painting which cement construction has forced upon him. It will tax the brain of the paint chemist to formulate the vehicle with which to absolutely destroy the alkaline base which cement surfaces are loaded with, and it will be necessarily slow in reaching us, for time and elements are the only factors which will buy time exposure, and to show whether they have arrived at the point of absolute elimination or of perfect assimilation of the vehicle with the cement surfaces that is coated, therefore, will require patient effort. We are all aware that the goal has not been reached by any means, but constant scientific research will land us in the promised land of perfection, as it is doing in every other line of industrial development.

Relative Values in Sanitation*

By Geo. C. Whipple†

SANITARY measures are not always directed to a common end. Some are chiefly and avowedly for the protection of the people against disease, as for example, vaccination, disinfection processes, and the sterilization by the use of chemicals of public water supplies. Some measures are to protect people against accident. On the other hand, many of our most conspicuous and expensive sanitary operations, such as refuse disposal, street cleaning, ventilation of buildings and cars, promote comfort and convenience more than health. Again we have the element of decency which, though intangible, is nevertheless an important factor in the situation, as it merges interceptibly into morals. The proper disposal of the excretions of the human body is influenced by this motive. Between health, comfort and decency we often find it hard to discriminate and in attempting to evaluate them we encounter at the outset a great variety of philosophical conceptions.

Where no common denominator exists it is hard to make comparisons. As a matter of fact life, health, comfort and decency are prime factors and we cannot reduce them to lower terms. And so in deciding between measures which perform one or the other service we can do no more than exercise our best judgment, taking into account the sum total of the advantages to be derived from the measures recommended and our ability to pay for them.

But in order to judge wisely in regard to these matters it is necessary to be correctly informed as to what can be accomplished by sanitation and what need not be expected. This demands a careful study of the facts by persons competent to draw conclusions from them.

Popular Misconceptions

The popularization of sanitary science has been both beneficial and harmful. So rapid have been the advances in certain directions, so marvelous, for example, have been the results of bacteriological discoveries, that a spirit of over-confidence in new ideas has been developed. A flabby gullibility is taking the place of robust criticism. This is due in great measure to the manner in which scientific studies are exploited or "featured" by the press. False and misleading headlines are read by the many, while the articles themselves, often of a very different tenor from the headlines, are read by but few; hence the quick reading public may get one opinion, while the more studious reader may get an entirely different opinion from the same page. When, as in one instance, public opinion is so influenced by diluted science as to cause the legislature of one of our states to propose a law requiring the sewage of all cities to be purified in a septic tank, the matter becomes more serious.

Hence one of the most important things to be done in considering relative values in sanitation is to educate the public as to what can be accomplished and what cannot be accomplished by the various sanitary measures that are continually being proposed.

A Few Comparisons

It may be interesting to run over some of the sanitary measures in common use with reference to the nature of their usefulness, bearing in mind that the statements made are very general in character and subject to modification under exceptional conditions.

The purification of public water supplies has a very important influence on public health. But apart from this influence clean water, as contrasted with water which is turbid, discolored, or ill smelling, has a value of its own.

Sewerage that is the removal of water closet wastes from human habitations, is an important health measure. Sewerage has also a value reckoned in terms of comfort and decency.

Sewage treatment, sometimes miscalled sewage purification, except in special cases, has but a small influence on the public health. Nevertheless it may be very important when judged by standards of comfort and decency.

Street cleaning has an influence on public health, but its value lies chiefly in comfort and convenience.

Refuse collection and disposal has but little direct influence on the public health. Its value lies chiefly in comfort and convenience.

The ventilation of buildings and other enclosed spaces is only to a slight extent a health measure. It relates chiefly to personal comfort.

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* Abstracted from a paper presented at the annual meeting of the Connecticut Society of Civil Engineers.

† Consulting Engineer, New York City, and Professor of Sanitary Engineering, Harvard University.

The congestion of population in the crowded districts of cities considered by itself and apart from the habits of the people, probably has less influence on the transmission of diseases than is commonly supposed, yet there is reason to believe that it has an important influence on what may be termed human vitality. Room congestion when associated with ignorance and poverty, is an important factor in public health.

The elaborate devices employed in house plumbing to prevent the entrance of sewer air and drain air into the rooms have but a slight influence on the public health. They do, however, promote comfort and may perhaps enhance human vitality.

The control of the mosquito by the elimination of bodies of standing water and the use of oil is in many places an important health measure. It is also an important measure considered from the standpoint of personal comfort.

The elimination of the fly by the control of its breeding place, chief of which is manure, is, in the absence of proper care of fecal matter and other body excretions, a measure which affects the public health. Likewise it is a matter of personal comfort.

It must not be understood that street cleaning, refuse disposal and sewage treatment, which are usually controlled by municipal authorities, have no influence on public health. Of course they do have an influence. But the minor cleansing operations performed by the people themselves in their homes and schools and places of business, the practice of personal habits as will prevent the transmission of living organisms from person to person through such agencies as the common use of papers, pencils, toys, drinking cups, and the like, have a greater influence. This results from the general principle that the most dangerous infection is recent infection and that in general the life of pathogenic bacteria outside of the human body is not long.

Municipal cleansing operations began before the world knew much about the transmission of disease by means of living organisms. The relation between filth and disease was suspected, however, and it is probably fair to say that most of the cleansing measures that have been in practice for many years were first undertaken chiefly from the motive of protecting the people against disease. While science has shown that their influence in this direction is less than was once thought, yet we may be justified in continuing them from the standpoint of comfort, convenience and decency. It is evident from the general tenor of current discussions and from municipal appropriations, that the general public still regards them as measures that relate primarily to health.

The safeguarding of food against infection and putrefaction is a health measure, but food sophistication is chiefly an economic question.

In general it may be said that mankind needs clean air, clean water, and clean food, and needs them, too, in sufficient amounts. The quantity of food as well as its quality is important, but this question runs away from sanitation into economics.

Cost of Sanitation and Health Conservation

In the recent special report of the United States Bureau of Census on the financial statistics of cities for 1912, figures are given which show the relative cost of those measures which tend to promote cleanliness, and which are classed under the general term sanitation, and other measures which more directly affect the health of the people. It is interesting to notice that more than four times as much money is usually spent for measures which affect the public health indirectly as for those which are directly influential in controlling disease. If we consider all of the cities of the country which have populations higher than 30,000, we find that the cost of sanitation amounts on an average to $1.42 per capita per year, while the expenses for health conservation amount to only $0.35 per capita per year. The figures in Table 1 show that the per capita expenses of both sanitation and health conservation increase considerably as cities become larger, but that the percentages which these expenses are of the total municipal expenses remain practically constant fo all cities whatever their size, averaging 8 per cent. for sanitation and 2 per cent. for health conservation.

If the saving of lives is to be placed above comfort and decency it would seem logical for many cities to increase the appropriation for the work of their health departments.

Very often the cleansing operations are considered as a part of the health expenditures. In the light of modern bacteriology this is unwarranted.

The Dollar for Dollar Standard

Let us now consider some of the standards that may be applied to the various sanitary measures. First we have what may be called the Dollar for Dollar Standard. If we in America are to be true to our caricatures we should put this at the head. We should do the things that bring dividends and keep clean and well because it pays in dollars and cents, and because it costs money to be sick and to die and to be buried. Although this argument has moral shortcomings it is sometimes used, and it must be admitted that the dollar, as a commensurable unit, has advantages.

The money standard may be applied in two ways, first as a unit measure of cost and, second, as a unit of value applied to the product. To the first use one can hardly take exception; the second is less exact, but even so it may be usefully applied. We say that pure water saves lives; that lives have a value; and that this value is subject to calculation. In this way we compute the effect of a water filtration plant in dollars and cents and compare this value with its cost to determine whether the filter is paying a dividend on the investment. Figured in this way we usually find that the filtration of a polluted water does pay a very good profit. For example, the filter in Albany, N.Y., which was installed in 1899 reduced the typhoid fever death-rate in that city from 104 to 26 per 100,000, and also decreased the death rate from other diarrheal diseases. Taking current assumptions for the value of the lives that would have been lost had the filter not been built, and assuming a daily water consumption of 100 gals. per capita, we arrive at the result that the value of lives saved was about $76 for every 1,000,000 gals. of water that was supplied and inasmuch as the cost of the process did not much exceed $10 per 1,000,000 gals., the filter may have been said to have yielded in its early days a sevenfold profit.

In the same way we may study the various sanitary and hygienic measures that relate to the saving of lives of young children, such as motherhood training by district nurses, the pasteurization of milk and the like, and here also we find that the value of the lives saved, estimated in dollars, is larger than the cost of the protective work and we can compute the profit. And so we might go through the list and find whether the money spent in the eradication of smallpox is a paying proposition and that for the suppression of tuberculosis, and whether hospitals pay and Red Cross nurses and the lighthouse service of the United States Government.

In doing this we should come across some unexpected results. For example, does the treatment of sewage pay as a life-saving agency? Most people at first thought would say "Yes," but on study the proof of this fails to materialize.

In considering sanitary expences on the dollar for dollar basis we find that money spent for some forms of sanitation reduces other costs. Cleansing of the atmosphere from smoke reduces the laundry bills, lessens the need of air washing, and furthers the growth of vegetation. Money spent for sewage treatment may mean that streams and harbors have added value as parks and playgrounds. Money spent for water softening means less money spent for soap and the care of boilers. In various ways one expense may be substituted for another with the enhancement of personal comfort as an additional item.

Value of Human Life.—In making these calculations we are in the habit of attributing a certain value to a human life. We say, perhaps, that a man of a certain age earns so much above his cost of support, that he has a certain expectation of life and therefore his prospective value to society is so much. Economically this is doubtless true. The man's dependents recognize it, but does society recognize it? Chapin asks this pertinent question. "When a man dies do the people who are left believe that their own wages would have been higher if the man had lived, by reason of his worth to society? If they think about it at all are they not more likely to argue to the contrary and say that, in accordance with the law of supply and demand, limitation of wage-earners tends to increase wages?"

Thus, however much we may compute and argue on economic grounds, the dollar for dollar standard does not appeal to the mass of people. Bond issues for sanitary reforms will not be voted in order to conserve human life reckoned as economic wealth. The saving of life for its own sake is a far more powerful argument for the establishing of life-saving agencies than any appeal to the pocketbook. Humanity, after all, is what counts.

Again we often hear this—I quote from a prominent sanitarian: "No expenditure can be too great if a single human life is saved. Life is priceless." From an individual standpoint this may be accepted, but the world knows that in the aggregate this is not true. If people actually believed that life was priceless wars would cease, and people would stop taking chances of accident in automobiles and aeroplanes. The theory of the priceless life carried to extremes would be ridiculous. What we call life-saving is in itself something of a misnomer. Actually it is only life lengthening. This is recognized in the new phrase that we are beginning to hear—"life extension."

The Life Standard

There is, however, a very proper and very useful way to employ the money standard in sanitation, and that is to find in what direction the expenditure of a given sum of money will save the largest number of lives. This is one of the greatest questions that a sanitarian can consider. It is today the most important of all hygienic problems because it comprehends all others.

We spend our money for life extension partly by the inertia of old habits and partly by the spur of each new discovery in science.

We take up the new ideas one by one and ofttimes push them to extremes, regardless of their relative worth. Their newness obscures their true value.

If the life-saving agencies are to yield their best results we must place them upon a quantitative basis. That is to be the keynote of the new era upon which we are entering. Some might call it "Efficiency in the conservation of life."

The Vitality Standard

Another standard which has never yet been put into actual use relates to the effect of municipal environment on the physique and vitality. Do cities yield as strong and healthy men as the country? Does good ventilation add to one's strength and stature? Does factory sanitation lessen the discomfort and the burden of toil as well as increase the efficiency of the laborers? As yet no means have been devised for applying this standard. Some weight should be given to it in comparing the relative value of sanitary measures. Health has its positive as well as its negative side. It would not be out of place to consider expenditures for parks, for fresh air excursions and for public baths as health measures.

The Standard of Comfort

Money and length of life are not the only things to be considered. It is what lies between one's birth and death that really counts. Of what avail to add a few years to the length of life if personal comfort and happiness are not also enhanced! What, after all, is the chief end of man, to live long upon the earth, or to obtain the best enjoyment from the best environment? Whatever may be our philosophy we must admit that our five senses deserve consideration. Judged from this standpoint, some of the sanitary arts which do not yield a dollar profit begin to loom large.

Clean streets, clean houses, clean cars, clean rivers and clean harbors have a value because they tend to make life more comfortable, more decent and more moral. Sewage treatment, while it does not pay large vital dividends, may yet yield a profit measured in terms of comfort and decency. To what extent can physical comfort and happiness be secured in a tenement house where people live crowded together 1,000 to the acre, 43 sq. ft. of land for each person, a square 7 ft. on a side, not much larger than a respectable lot in a cemetery? The greatest evil of congestion is that true home life is rendered impossible. The greatest evil of machine labor is that the laborer gets no mental pleasure from his work. The lack of home comforts and comfortable working conditions is bound to influence both vitality and health.

Sanitary Surveys

In applying these general ideas to any particular case it is necessary first of all to obtain a general view of all the local conditions. This demands a sanitary survey.

The sanitary survey is not a new idea. Such surveys were made in many cities of Europe and America 50 and even 100 years ago. The histories of the surveys made in Boston, New York and elsewhere are of great interest and deserve careful study by modern sanitarians. In our new surveys we find history repeating itself—but with one difference. We now have a knowledge of the germ theory of disease and this has resulted in a changed point of view.

The planning of a sanitary survey should be placed in the hands of some one sufficiently familiar with all phases of the problem to give each its true value. Usually it is preferable to have it conducted with the co-operation of the municipal authorities, for they alone have access to the most important statistical material. For example, the survey which is being conducted in Cambridge, Mass., is in charge of a commission composed of the city engineer, the superintendent of streets, the health officer and two university professors. The results of such surveys are likely to show unbalanced allotment of the funds devoted to sanitary work. A slight readjustment might result in the saving of many lives. When the practice of sanitary surveying has progressed somewhat further than it has, it may be desirable to standardize the methods of expressing the results. Possibly a system of grading the sanitary conditions of cities may be devised, similar to the scoring system now applied to milk farms.

An important part of any sanitary survey is the study of the vital statistics of the community under investigation. This must not be confined to a mere study of crude death rates. It is necessary to take into account births as well as deaths and so consider the composition of the population as to age, sex, nationality and occupation, and social and economic conditions.

Perhaps no branch of science has had more misuse than that of vital statistics. In this respect we are behind, and not ahead, of the statisticians of former days. We are too much inclined to deal with crude death rates and general averages, quite forgetting that the individual observations are of much more importance than the average. We do not analyze our statistical material with that degree of care which is necessary to a full understanding of the facts. We are likewise inclined to make statistical comparisons of data between which there is no causal relation. During the last generation there has been a marked decrease in the crude death rate in cities the world over. We have been too quick to assume that this decrease has been due to improved sanitation and the rise of the science of bacteriology. To be sure this has been an important influence, but we forget that a large part of the decrease has been due to falling birth rates and immigration of people of middle age and that there are close relations between death rates, birth rates, marriage rates and economic conditions. We also see it stated that the sanitary condition of a city is measured by its infant mortality rate, a fact which does not appear to be borne out by statistical evidence. The death rate from children's diseases has been steadily decreasing for a generation and this may be fairly attributed to improved environmental conditions; but it is only within a comparatively short time that infant mortality rates have declined and this decline appears to be associated more closely with motherhood training than with sanitation.

Finally, what is most needed is a careful correlation between vital statistics and the sanitary conditions of our cities. This demands a minute analysis of the statistical material. At present our health department reports are utterly inadequate to enable the necessary correlations to be made. In order to determine relative values in sanitation it will therefore be necessary to develop anew the science of demography, a science destined to profoundly influence the health, lives and morals of the race.

The Decorative Value of Concrete

In a recent issue of the American Architect the possibilities of concrete for artistic construction are discussed in a leading article, the following extracts from which will probably interest many of our readers. Our contemporary points out that many of the economic conditions existing to-day parallel those of the Roman Empire which two thousand years ago led to the extensive use of concrete, though in less variety of purpose than it is now employed. Brick and building stone are not always locally available along the lines of railroads, and are always expensive to transport. Further, their use requires the services of workmen who, in many instances, must be brought from a distance, maintained, and paid a rate of wages based on supposed, but not always realized, efficiency.

The materials for concrete, however, are easily and cheaply available in almost any locality. Aggregate suitable for most kinds of concrete, if not taken from the actual excavation, may almost always be found near it, and as cement is manufactured in many centres and its weight comprises but a small fraction of the total, the cost of transportation is comparatively small. The mixing and putting in place of the concrete is efficiently, quickly and easily accomplished by the joint efforts of machinery and a ready supply of cheap labour, under skilled superintendence.

Economic and other advantages having directed attention to concrete, its use was for a long time devoted almost exclusively to the more massive forms of construction, such as foundations, piers and heavy retaining walls. But as economic conditions in certain circumstances become more insistent and some of the inherent virtues of the material become more obvious, the attention of a few architects was perhaps unwillingly drawn to the architectural treatment of a material which clients importuned them to use.

Naturally, the first tendency to make the surface of concrete simulate that of building stone, was too strong to resist even by those who most loudly preached the policy so that its face shall have even the mechanical form of stone ashlar, or to simulate joints on the surface of a monolithic wall for the same purpose, is an obvious attempt at deception. Such treatment not only asserts a quality which is lacking in concrete, but denies the user the advantages of its unique qualities. There are its plasticity, permitting it to be cast or moulded in forms of any size and almost any shape, and its composition of cement and aggregate making possible a great variety in surface treatment.

Perhaps the greatest opportunities for the architectural treatment of concrete are in the broad wall surfaces of monolithic construction. For precedents we have been referred to the stuccoed walls of the California missions with their unaffected simplicity and agreeable proportion and spacing of openings. We cannot afford to neglect any suggestions based on tradition when wrestling with a new problem, but the pioneers who have been most successful are those who have studied the problem and have worked it out on its own merits.

Concrete can no longer be regarded as a gross material suited only for heavy, massive construction; it is a plastic material and comprises an aggregate which, when properly selected, makes possible an infinite variety of effects in an infinite number of forms. There has been recently a considerable appreciation of its possibilities, but the future architect will undoubtedly develop these even more broadly.

Montreal Builders' Exchange

As the result of a further meeting of the Montreal Builders' Exchange to consider the situation created by the war, it was decided to appoint committees to approach the Bankers' Association or the Minister of Finance with a view of securing more money for building purposes; to interview the Government and the wholesale people in Montreal on the subject of the price of foodstuffs; and to consider the question of a wages scale for all classes affected by the contracting business. The chief topic of discussion was on the latter question, and there was considerable difference of opinion as to the wisdom of attempting to cut wages with the object of inducing capitalists to restart building operations. It was pointed out that many contractors have agreements with the Unions, and the former ought to stand by these agreements. On the other hand, it was said that it is certain people with money will not build unless some inducement in the way of lower costs is held out, and that it is better for workmen to accept say 30 cents an hour than to practically starve. It was made clear that the Builders' Exchange has no desire to reduce the scale of wages, and that the suggestion of a lower scale is with a view of keeping the trade from utter stagnation.

The question of the cost of builders' supplies was also raised, and it was said that the prices of materials are excessive. Other speakers made strong complaints of the action of banks in restricting loans to firms, thus preventing work being carried out.

Mainly Constructional

East and West—From Coast to Coast

EASTERN CANADA

Toronto's share of the cost of the Toronto-Hamilton road will probably be $150,000. A grant to this amount is favored by Council.

The annual convention of the Royal Architectural Institute of Canada, which was to have been held at Quebec this week, has been postponed indefinitely.

At Toronto, the International Petroleum Company, Limited, has been incorporated with a capital of $20,000,000, to carry on a general oil and refinery business.

Excavation has started on the new Registry Office which is being built at Toronto at a cost of $400,000. The architect for the building is Mr. C. S. Cobb, of Toronto.

It is of interest to note the incorporation at Montreal of the St. Denis Theatre Company, capitalized at $750,000. No announcement as to building plans has yet been made.

Plans have been prepared for the one-million-dollar factory to be erected at Hamilton, Ont., by Messrs. Proctor & Gamble, of Cincinnati, Ohio. No contracts have yet been awarded.

Announcement is now made that operations will be commenced shortly on the Toronto-Hamilton highway, under the direction of the provincial government. The estimated expenditure is $600,000.

The Hamilton, Ont., Board of Control have recommended a grant of $20,000 towards the construction of the Hamilton-Toronto road, and an additional $10,000 to pay Hamilton men engaged on the work.

Work on the completion of the National Transcontinental Railway is being rushed forward. Eleven thousand men are now engaged. The expectation is that the whole line will be ready for operation by October.

The City of Hamilton is about to call for tenders upon material for building a mile of concrete sewers, estimated to cost $110,000. The work is to be done by day labor. Mr. A. F. MacCallum is the City Engineer.

At Collingwood, Ont., operations are proceeding on the post office building, which the Dominion Government is erecting at a cost of $108,000. The general contractors are Messrs. Healy, Herrington & Bryan, Collingwood.

The Ottawa City Council have approved the plans of Messrs. Hazen & Whipple for the Ottawa River water supply and have instructed the Board of Control to expedite construction in order to provide employment this winter.

At Quebec, arrangements are already being made for extensive municipal improvements next spring. The expenditure on sewers, watermains and roads mapped out so far runs into two million dollars. Mr. W. D. Baillarge is the City Engineer of Quebec.

At Windsor, Ont., the Canadian Bank of Commerce will erect a new bank at a cost of $150,000. The building will be four-storeys high and of fireproof and brick construction. Excavating has commenced. The architect is Mr. D. G. Horsburgh, Toronto.

Plans are being prepared for the new central station which it is proposed to erect at Quebec at a cost of $1,000,000. The building will be the joint project of the Canadian Pacific and Transcontinental railroads. The architects are Messrs. Palmer, Hornbostel & Jones.

Tenders are about to be called for the erection of the new office building which the Ontario Hydro-Electric Commission proposes to erect on University Avenue, Toronto, at a cost of $300,000. The contractor for the excavating is Mr. W. H. Thomson, who has started work.

The Toronto City Council has adopted the report of the Board of Control recommending the installation of a garbage disposal plant at $480,000 and tenders will be called as soon as the plans are complete. As announced previously in these columns, the scheme embraces the erection of four separate plants. The Toronto Street Commissioner is Mr. G. B. Wilson.

For the first time, the Association of American Portland Cement Manufacturers have held their annual convention in Canada. The convention was held on September 14-17 at the Windsor Hotel, Montreal. There were about 150 delegates. Committees presented reports on "Technical Research," "Uniform Cost Sheets," "Conservation" and "Accident Prevention." These and other subjects, including concrete roads, were discussed. The delegates visited the No. 1 plant of the Canada Cement Company at Pointe aux Trembles, the harbour, and the new grain elevator, and also went down the Lachine Rapids.

WESTERN CANADA

Saskatchewan has set an excellent example in providing work on road construction for 150 crews of men. The expenditure to be made under the Provincial Highways Commission is not less than $500,000.

The progress of road construction in Saskatchewan is highly satisfactory and the work of the Provincial Road Commission has come in for considerable commendation. More than 1,500 men and 1,000 teams are now at work.

One day of the International Irrigation Congress, which is to be held in Calgary, October 5 to 9, this year, is to be devoted to a trip covering a 160-mile journey through the irrigation block lying to the east of Calgary, and a visit of inspection to the Horseshoe Bend dam near Bassano, which stores water for the largest individual project on this continent.

The City Council of Vancouver are inviting competitive designs for the development of the proposed civic centre. Premiums amounting to $500 and $250 will be given to the first and second designs respectively. The closing date for entrance is November 30.

The McLeod Block, Edmonton, which is involving an expenditure of $450,000, is nearing completion. The building is a ten-storey structure, faced with terra cotta and brick. The architect is Mr. J. K. Dow, of Edmonton, and the general contractors are Messrs. Olson & Johnson, of Edmonton.

From Regina comes the cheering information that municipal work estimated to cost $380,000 is to be put in hand immediately. The City Council has drawn up a programme which means employment for a large number of men this winter. One of the items is a five-million-gallon reservoir.

Messrs. Sutherland Construction Company are the general contractors for a warehouse which is to be erected at Ross and Ellen streets, Winnipeg, at a cost of $125,000, by the Midland Railway Company of Manitoba. The building will be two storeys high, 400 ft. by 70 ft. in dimensions, of pressed brick construction.

Foundation work has been completed for the proposed armoury at Prince Albert, Sask., which is to cost $250,000. The architect is O. Albrechtsen, of Prince Albert, and the general contractors are Messrs. Piggott & Healy, of North Battleford. The Manitoba Bridge & Iron Works, Winnipeg, have the contract for the steel.

An additional $40,000 is to be expended on the new drill hall now in course of construction at Victoria, B.C. This will bring the outlay to nearly $300,000. Work is being started by the contractors, Messrs. Parfit Brothers, and it is hoped to have the building ready early next year. The architect is Mr. Ridgway Wilson.

At Winnipeg, constructional operations are proceeding on the new warehouse for the Midland Railway Company of Manitoba. The building, which is estimated to cost $125,000, will be two storeys high, 70 ft. by 400 ft. in dimensions, of pressed brick construction. The general contractors are the Sutherland Construction Company, Winnipeg.

Operations are progressing on the store and office building which John Kelly is erecting at Edmonton at a cost of $125,000. The construction is reinforced concrete and brick and the building will be five-storeys high. The architects are Messrs. Van Siclen & Macombe, and the general contractors are the Zenith Construction Company, both Edmonton firms.

An important Order-in-Council of vital interest has been passed covering the contract for a subsidy with the Amalgamated Engineering Works, Limited, of British Columbia for the construction of a modern drydock at Vancouver, to cost $6,500,000. It is understood that the financing was completed in London before the war broke out. The proposed drydock will be 1,150 feet long and 100 feet wide, and capable of being divided into two sections, one 650 feet long and the other 500 feet. It will be one of the largest drydocks in the world. The subsidy will cover $5,500,000. This scheme has no connection with the plant now being erected for the Dominion Drydock & Shipbuilding Company, whose site is located near this project.

Good progress is being made with the construction of the big Grand Trunk Pacific drydock at Prince Rupert. This dock, costing $3,000,000, will have in all twelve pontoons. The first of these was launched last week. It is 130 feet long and, exclusive of other fittings, has 300,000 feet of timber in its construction. A second pontoon is to be launched on the 22nd inst., and six pontoons will be completed by January 1st. The capacity displacement of the series will be 20,000 tons, and each pontoon will be fitted with two powerful centrifugal pumps, so that when the ship is in place the water can be pumped out rapidly and repair work begun. The dock is so arranged that it can be used in three separate units, or in any combination that is desired. A large number of men are employed on the construction work. The dock is only one of many large projects Prince Rupert has on hand at present.

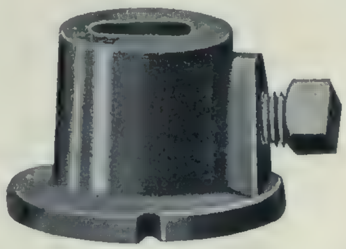
Industrial Notes

The Toronto Plate Glass Importing Company, Limited, have opened an office at 1010 New Birks Building in charge of Mr. A. P. Major.

Witting Bros., Limited, glass and metal importers, with head office in London, Eng., have removed from 46 Notre Dame Street West to larger offices at 403 McGill Building, Montreal.

The Universal Form Clamp

The Universal Form Clamp, an illustration of which appears herewith, is finding much favor among concrete contractors. The device has been used on many of the large buildings under construction this season, and over two thousand clamps are at present in use on the erection of the new Canadian Kodak Building. It is claimed to be a positive locking device when used upon a rod, and its action is the same as a bolt or nut with this distinction, however, that the tie is secured in fifty per cent. less time. The Railway-Contractors Supply Company, Toronto, are agents for Ontario and Eastern Canada. They have appointed Messrs. Ramsay & Kelly, 511 Quebec Bank Building, Montreal, their representatives in that territory.



The Canadian Dolarway Paving Company, Limited, have just completed the repairing and resurfacing of Wyandotte Street, Windsor, with Dolarway Bitumen. When this contract was awarded, a by-law had been passed, providing for the construction of the work with asphalt blocks, at an estimated cost of $63,000. The Dolarway construction, which is guaranteed for three years, has effected considerable economy.

We have become accustomed to using electrical goods which are "made in Germany" for such a long time that we are apt to wonder how we are to get along now that we are cut off from that country. In this connection it is refreshing to note that Pulsynetic Impulse Clocks are a "home-made" production, being manufactured at the works of Gent & Company, Limited, of Leicester, Eng. It may be mentioned also that "Invariable" of non-expanding nickel steel for pendulums was almost exclusively a German production until Gent & Company, Limited, some years ago introduced British-made "Sinevar" non-expanding nickel steel. "Sinevar" steel has a co-efficient of expansion of only .0000010 per degree centigrade and all Pulsynetic Time Transmitters are fitted with pendulums of this extremely useful alloy, which accounts largely for the remarkable time-keeping which can be obtained from these instruments.

Contracts Department

News of Special Interest to Contractors, Engineers, Manufacturers and Dealers in Building Supplies

Waterworks, Sewerage and Roadways

Edmonton, Alta.

City Council is to carry out construction of two miles of paving on Stoney Plain Road, 18 ft. wide. National Paving Company, First St., is general contractor.

Fort Erie, Ont.

Tenders are invited by J. H. Jackson, Engineer, Ellis street, Niagara Falls, for construction of Concrete Roadway for Town Council and Victoria Park Commission, at estimated cost of $30,000. Plans and specification with engineer.

Galt, Ont.

Town Council is constructing concrete wall on west side of river.

A by-law is to be voted on for construction of 4 ft. cement sidewalk on east side of Lowell St. Jas. McCartney is the clerk.

Hamilton, Ont.

Tenders will be called shortly for material in connection with construction of one mile concrete sewers in East End, at estimated cost of $110,000. City will do work by day labor. A. F. Macallum is engineer.

Medicine Hat, Alta.

Mayor Brown has recommended expenditure this year of $50,000 on cement walks. Herbert Baker is clerk, and A. K. Grimmer engineer.

Montcalmville, Que.

Work is to start next spring on construction of sewers, water main, sidewalks, etc., at estimated cost of $2,000,000, for City Council. W. D. Baillarge, 50 St. Louis St., is Engineer.

Ottawa, Ont.

The construction of asphalt pavement on Primrose Avenue is contemplated by the City Council.

City Council is contemplating construction of Asphalt Pavement on Gloucester St. F. C. Askwith is Engineer.

City Council has instructed Board of Control to commence work on Ottawa River Water Works Supply system, estimated to cost $2,000,000. Consulting engineers, Geo. W. Fuller Company, New York City. City engineer, Arch. Currie, City Hall.

Owen Sound, Ont.

Town Council has authorized construction of concrete roadway on 10th Street, at estimated outlay of $500,000. Work will commenec shortly. Union Cement Company is supplying cement at $1.40 per barrel.

Regina, Sask.

City Council having raised necessary amount for completion of 5,000,000-gallon steel and concrete reservoir, work is to commence. J. M. McKay is the engineer.

City Council has authorized construction of sewers on 15 streets and watermains on 12 streets. Estimated cost $50,000.

Revised estimates place contemplated extension of Sewage Disposal Works, including construction of additional filter beds, at $50,000. F. McArthur, engineer, is in charge of the work.

Saanich, B.C.

The Municipality is voting on bylaw to raise $375,000 for water system and construction of water mains.

The Municipality has decided to expend $450,000 on Street Paving and Grading. Hector S. Cowper is the clerk.

The cost of grading and paving road scheduled for in paving plans and as set forth in by-laws soon to be voted on are as follows: Quadra Street, $10,000 and $46,000; Saanich, $33,500 and $174,000; Burnside Road, $37,500 and $42,000; Gorge Road, $5,250 and $31,000; Douglas Street, $2,850 and $25,000; Shelburne Street, $18,000 and $52,200.

St. Catharines, Ont.

Work is to start at once on construction of asphalt concrete pavements on six streets, approximately 25,000 square yards. Estimated cost $50,000. Foley & Gleeson, Central Chmbrs., Ottawa, General Contractors. W. D. Near is Engineer.

Toronto, Ont.

Tenders close September 29 with Board of Control, for construction of Asphalt Pavements on ten streets, Bitulithic on two streets, Brick Block on two, Concrete on four; also Curbings and Walks.

Provincial Highway Commision is to proceed shortly with work on Concrete Roadway, for 33 miles between Toronto and Hamilton, under direction of Special Commission to be appointed by Provincial Government. Roadway will cost $600,000. Mr. W. A. McLean, Provincial Parliament Bldgs., is the Engineer.

Vancouver, B.C.

The engineering staff of Vancouver and District Joint Sewerage and Drainage Board has completed plans and estimates for proposed Sewer on Balaclava Street. Work will be done by day labor and construction will probably be started at once.

Victoria, B.C.

City Council has approved of a paving programme for Duchess St. Wellington J. Dowler is the clerk.

Winnipeg, Man.

Estimates are prepared by W. P. Brereton, engineer, for construction of plank sidewalks on city streets.

CONTRACTS AWARDED

Galt, Ont.

Town Council has awarded general contract for construction of bitulithic pavement on Ainslie St. N., to Warren Paving Company of Ontario, at $1.55 per square yard.

Kingston, Ont.

City Council has awarded general contract for paving of Princess St., to Kingston Construction Company.

New Westminster, B.C.

City Council has awarded general contract for construction of Sapperton sewer outfall on Columbia Street, to R. W. MacLean, Pacific Bldg., Vancouver. Estimated cost, $76,313.

Niagara Falls, Ont.

The contract for 1,700 square yards of concrete sidewalks has been awarded to Ferris & Manley.

St. John, N.B.

The following contracts have been awarded by City Council: Concrete Base and Sidewalk on Queen Sq., Moses, French & Simes, 29 Brunswick St., $2,517.32; Concrete Retaining Wall and Sidewalk on Tower St. W., $687, Peter Ferris, 24 Brunswick St., General Contractor, and F. L. Potts, Commissioner of Works.

Toronto, Ont.

The following contracts for sewer construction have been awarded by Board of Control; Danforth Avenue, National Contracting Company, $1,698; West Toronto Sewer System, division No. 2 outlet, W. E. Taylor, 138 Clinton Street, $4,895; Armadale, $2,169, Glendonwynne, $2,360, Windermere, $5,365, Connolly Agnew Company, 606 Avenue Road.

Board of Control has awarded the following contracts for asphalt pavements: Coxwell Ave., $15,947; Leslie St., $11,590 to Constructing and Paving Company, Confed. Life Bldg.; St. Clair, $16,266; Langford, $11,827; Earle, $2,577; Gothic, $9,946; Coxwell Ave., $8,535, to Commr. of Works.

The following contracts for construction of bitulithic pavements, etc., have been awarded by Board of Control:—Commr. of Works, Alexandra Boulevard, $7,475; Hillcrest Drive, $8,380; Lytton Boulevard, $8,510; Bathgate, $11,787; Turner Road, $5,416; Ashdale, $11,062; Bracondale Hill Road, $2,038. Contract for curbings on Humberside has been let to W. E. Ransom, Dineen Bldg., and sidewalks on Beech Avenue, to Riverdale Concrete Paving Company.

Railroads, Bridges and Wharves

Edmonton, Alta.

Surveys are being made by C. F. Law, Athabasca Landing, preparatory to construction of railroad in North Alberta

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Alphabetical Index of Advertisers Page 18

Vol. 28 September 30, 1914 No. 39

Principal Contents

An Eye Beyond the Immediate Future 1205
The Genesis of Design 1206-7
Loss of German Products 1207-8
Rebuilding the Pitt River Bridge 1208-10
Lock Gate Lifter for Trent Canal 1210-11
Rebuilding a Bridge Five Hundred Years Old ... 1211-12
The Salvage of Road Hauling Machinery 1212
Progress of Toronto's Twenty-Five Million Dollar Harbor Development 1213-17
Economy of Concrete Bridges 1217-18
Daniel B. Luten
New Type of Driver for Large Concrete Piles ... 1218
Shoulders for Concrete Roads 1219
An Orillia Building Which Exemplifies Up-to-Date Factory Design 1220-22
The Concrete Superintendent 1222-23
The Use of Filter Wells and Filter Cribs 1223
Economic Factors Involved in Road Construction in Strictly Rural Sections 1224-28
Large Works Completed by the C. P. R. 1228
Constructional News 1229

An Eye Beyond the Immediate Future

One cannot emphasize too strongly the necessity of our taking careful stock of the European situation. Whether we like it or not we shall be forced to take part in the general adjustment of British trade which will follow the cessation of hostilities. We may rest assured that there will be no compromise with German manufacturers. At present, be it said, it is unlawful for local authorities in any part of the Empire to trade with the enemy, and it is safe to assert that the embargo on German trade will be relaxed very gradually in our day and generation. Great Britain will be slow to forget how she once contributed to the upbuilding of a great German army by purchasing German manufactures and materials freely—how she contributed to developing the sinews of war at the cost of her own industry and at the cost of thousands of lives.

Few people in Canada know the extent to which British industries have been over-run by the Germans. Some of the most flagrant cases have been held up lately before the public of the old country. Two of the examples given are the London Asphalte Company, Limited, and the British Ceresit Waterproofing Company, Limited. The directors of these concerns are as follows:

London Asphalte Company, Limited.

Carl Henitz, 244 Goltsteinstrasse, Cologne.
Leo Jacob Tutt, Finsbury-Pavement House, E.C.
Ernest von der Wettern, 5 Uriel King, Cologne.
Alexander Ruthemeyer, Wiesbaden.
Gustave Utz, Wiesbaden.
Emil Ruthemeyer, 15 Almirfelstan Grosse, Dusseldorf.

British Ceresit Waterproofing Company, Limited.

Eric von Schwarze, of London.
Leopold Heppe, of Unna, Germany.
H. Von der Heide, of Unna, Germany.
Otto Funcke, of Hagen, Germany.

This sort of thing will be tolerated no longer. Germans parading under the cloak of British industry and assuming British names will stand no more chance than a German spy disguised in British uniform. Germany itself has shattered the great trade which in a few spectacular years it had established in a position approaching supremacy. The German has got to go, bag and baggage. Whether he be a victim of the Kaiser's system or not, British public opinion will not tolerate him. No weak-kneed plea that the German people had no part in the organized conspiracy against Great Britain can be accepted. Such acceptance would be to mock the brave men who are giving their lives in defence of Empire. For years the German will remain an unsavory reminder of the bloodiest and most wanton iconoclast the world has ever known.

In Great Britain, therefore, undoubtedly there will be a great revival in British-made goods, and in this revival Canada will have a proportionate share. With a renewal of constructional activity in the Old Country, there will be a greatly increased demand upon the British manufacturer. Part of this demand will be diverted to Canada and within a few years we shall see many of the leading British firms establishing branches here. They will be confronted with a growing demand at home and they will have to meet orders from Canada and other parts of the Empire—and the expansion cannot be confined entirely within the "right little, tight little island."

In some of the diverted export trade our neighbors to the south will have their share—and they will have it ungrudgingly. A case in point is Germany's export to Great Britain of an enormous annual tonnage of cheap steel at prices which cannot be approached by British manufacturers, even with their commonest brands and at the sacrifice of all profit. Now, owing to the cessation of imports from Germany, British manufacturers in this field are coming into their own and in short order we shall find the United States in possession of at least a portion of the surplus trade.

Another phase of the question is that British industry must be prepared to make a swift bid for the trade with other countries which Germany will lose. Take, for example, Japan, with whom Germany is now at war. One will hardly question the assertion that German-made goods will be tabooed by the Japanese. What, then, is to take the place of the manufactured articles which Germany has been sending in to Japan with increasing activity year by year? Last year Japan imported German products to the extent of $34,000,000. This compares with British imports of $61,000,000 and United States imports at practically the same figure. Will Canada have no share in the re-adjustment of Japan's thirty-four million dollars' worth of German imports? Take machinery. Japan must continue to import machinery on a large scale, for in spite of her great industrial progress she will not be able to compete successfully with European and American manufacturers in these lines for many years.

Then there is South America. The opening of the Panama Canal cannot fail to enhance greatly the opportunities for the British exporter, and Canada must share in the gain which will come to North America. By far-sighted business men great interest is being taken in the possible openings in South America suggested by the disappearance of the German mercantile marine; and here, almost at our doors, we may look for a fresh field of industrial conquest.

To speak of industrial conquests by Canada would appear to some people to be visionary, in view of the character of the home demand, but looking ahead with an eye to opportunity one must be visionary. Canada has opportunities in prospect which it is impossible, at the moment, to estimate. All that we can do is to look with reasonable certainty to the time, not so far distant, when the patient beginnings of private enterprise have developed into great national undertakings whose ramifications extend to the uttermost parts of the earth. Well may we commit ourselves to a policy of active, though conservative, business confidence during the period of conflict, having reasonable assurance that the British Empire will emerge from hostilities purged of a foe menacing and ungenerous alike in peace and war.

The Genesis of Design

IN a state of order, all things stand in reciprocal relation; law connects part with part, and part with whole. In practical design our drawing-boards insure, mechanically, correlation to a certain limited extent; for each horizontal drawn with tee-square is true to base, each vertical is at normal angle. In earlier days, no doubt, the designer wanting accurate mechanical aids would have needed to exercise his mind in maintaining true horizontal and vertical, just as the mason constantly applies line and plummet. It may be that this necessity for continual vigilance gave a certain nobility to the work of the designer in primitive times; that his self-reliance was fostered, and forcefulness and character were engendered. We need but casually look round to assure ourselves that our present-day excellence of instrument and appliance does little to open the eye to an understanding of true symmetry and grace of form, for assuredly we see no end to the production of disorderly and warped architectural mass. We may agree that the basis of design is order, and that order means correlation of part; but the worship of the so-called picturesque in place of quiet dignity, shows that in practice we frequently ignore fundamental principles to which, in theory, we profess allegiance. This is a matter of regret, since if we earnestly seek some main guiding rule in design, we may find it in the principle of correlation, whereby each thought and act in design has definite relation to some over-ruling master idea. Holding to this principle, we may be saved from wanton acts, destructive of unity, and make each thought observe a general thesis. Each act of design is then comparable to a line drawn with tee-square; it is made true to a base. In the sum, such acts correlate, are laid, as it were, course on course, to line and plummet.

If we inquire why mere geometrical correlation, mere placing of objects at equal distances, at certain angles, on certain balanced curves—why parallelism, co-ordination and concentricity alone, of themselves are causes of interest to the eye and convey a sense of beauty, we shall find these questions in great part answered, if we consider correlativeness as the essence of order, and order the genesis of design. Each part has reference to other; the whole is bounded and bonded by a common, all-dominating law. Whether it be jewelled pendant, concentric circle in rain-splash and ripple, or iso-curving wavelets in a wide-sweeping bay, beauty in major part seems to reside in the sense of order, the existence of law, and the general subservience of part to whole effect. Geometry, as such, we may conceive to have no aesthetic import; but geometry as signifying law and order, and as indicating reciprocal relation of part, such as we see demonstrated in equidistant columns and the regular spacing of flutes, is no doubt the hidden cause—the fount and origin of beauty in architecture.

Geometry, as a concrete expression of order, appears rather an attribute than an entity in architecture. The display of severe elemental geometric form itself is not the aim. The orderliness and correlativeness of geometry runs through and through architecture as bond-entwining correlativeness—order; but if the end and aim of architecture were merely the exhibition of geometrical form, as such, and the ultimate effects were governed by this, plain iron sheds would be types of architectural beauty! When, therefore, we set so much store on order and correlativeness and the super-domination of the geometrical, we refer rather to an invisible warp and weft intermeshing and bonding part and part into unity.

There may be nothing of special interest, and obviously no novelty, in displaying the circle, as such; yet all objects of art founded on the circle possess its inherent beauty, and have an interest born of outcoming from—the circle. The relation of part to whole—the correlation, or sign of order, is here at its simplest; all refers to a centre, be it ring, wheel-window, or round moon. In the wheel-window the mullions may radiate, bringing another feature of design under one law; but the wealth of varied interest that the Mediaeval builders threw into circular windows shows that, given the circle as frame, the greatest prodigality and play of line and curve, within the circle, do but add gravity to effect. This is but natural, and an affair of mutual enhancement. The four straight and square lines that define a marble panel are the foil and contrast whereby the utmost value is given to all its natural, asymmetric markings and figure.

These considerations suggest that even order—correlativeness—needs some counterfoil; that is to say, reciprocal relation may be heightened in value by the juxtaposition of something akin to disorder. It seems almost impossible to employ such a term in design; but wild asymmetry, as the figuring of marble, does unquestionably derive increased value from close proximity to severe and simple geometrical lines. We must allow a place in architecture to the grave and gay, just as we employ the bass and treble in music. If we give too great heed to geometrical disposition; if our design is all right lines and right angles, we gain dignity, but lack variety. For the designer, this is a consideration of importance, for it shows that even order itself requires foil or contrast, and that the plumb and square parts of ruined architecture appear more so in the face of decayed and crumbling litter; and the spirit of the same principle we may see where right-angled leaden lights frame and empanel lace curtains and the flowering plants of cottager's window.

The principle of correlation induces us to render more pronounced and apparent geometrical form; but the need for variety and foil warns us not to carry the rule too far. If we never go outside our principle, or rather, if we never allow a little play or fancy and abandon, all lightness—the magic and charm of variation—would be stifled. All we need to see is that the change and variation does not occur in weighty matters; that we do not play with form in grave and serious main masses of building. It is in careless treatment of such building masses that want of respect for our principle of correlation—want of a high sense of order—is mainly evidenced. In the preservation of simple mass resides dignity. If we believe that order is reciprocal relation of part, we shall carefully avoid senseless break and change. Looking back into the ages, we shall find ample confirmation in support of these views. All great works convey an impression of a high sense of order, of over-ruling law, and, in each, a dominating theme or idea, to which every thought and effort of the designer has been subservient.—Building News.

Big Business of the Nations

The United Kingdom has a foreign trade of $6,830,000,000, its imports are valued at $3,741,000,000, or $652,000,000 in excess of all exports, domestic and foreign. Germany in 1912 had a foreign trade of $5,059,000,000, imports being $2,754,000,000, or $449,000,000 in excess of all her exports. France showed a total trade of $2,884,000,000 in 1912, her imports exceeding her exports by $293,000,000. The United States for the year 1913 had a foreign trade of $4,277,000,000, her imports being $1,793,000,000, and exports of domestic and foreign goods (chiefly domestic) being $2,484,000,000.

Loss of German Products

OUR New York contemporary, the Engineering News, waxes somewhat pessimistic in regard to the loss of German products. We reproduce an editorial which appeared in a recent issue of the News and invite readers of the Contract Record to send us an expression of opinion as to supplementary sources of the supplies the loss of which our contemporary deplores.

"It is only giving credit where credit is justly due to say that there is probably no other nation in the world whose sudden isolation commercially would cause such widespread loss as has been caused by the isolation of Germany. It is appropriate that this should be recorded here because Germany more than any other nation has won its important place industrially, not by reason of its wealth of natural resources or its geographical location, but by the skill and intelligence with which its people have attacked modern technical problems.

"While engineers and chemists are generally aware of Germany's leadership in the field of science and technology, the events of the past few weeks have been a great object lesson to the general public. Few have realized the extent to which the whole world has relied upon German scientists, chemists, engineers and manufacturers, for the supply of many materials necessary in the arts. Manufacturers in America and in England who were congratulating themselves on their enlarged opportunities for foreign trade in markets where the supply of German goods was cut off have in not a few cases found their own productive operations seriously hampered because they could no longer obtain certain materials from Germany.

"As is well known, steel manufacturers were greatly worried to know what they were to do for their supply of ferromanganese. Manufacturers of fertilizers have had to face the possible shutdown of their works through the cutting off of the supply of German potash. In the textile industries, manufacturers suddenly realized that with access to German ports blockaded by warships there was every prospect that the supply of dyes and dyeing materials would be seriously interfered with. In the drug and chemical trade, prices doubled and trebled when it was realized that with further supplies from Germany cut off, the world would have to get along for a time without certain drugs and chemicals which have become well nigh essential both in the pharmacy and in certain industries.

"The above list might be greatly extended. It is in fact only a statement of a few of the important staples, in the production of which Germany has been so pre-eminent that all the rest of the world has relied upon her to furnish them.

"Surely, from a broad point of view, the victory which Germany has gained over the nations of the earth by its leadership in the conquest of the most difficult fields of industrial technology actually surpasses as a meritorious achievement any victory which its great military organization may gain by brute force.

"It is said that most of these things for which we and other nations have been accustomed to rely upon Germany, could be produced here if necessary. This is true as relates to most of the materials, provided sufficient time were available, but sufficient time in most cases is a very long time. In the fertilizer trade, for example, investigations have been in process for a number of years looking to the production of potash from natural sources in the United States. But what has been actually accomplished commercially is the merest trifle compared with the demand which must be supplied. To develop plants which will produce the amount of potash required by the fertilizer trade and other consumers in the United States, and at a cost consistent with commercial necessities would require not months but years. Farmers and fertilizer manufacturers are anxious to know what they are to do in the meantime.

"The same thing holds true of numerous materials in the dye and chemical trades. Physicians and druggists accustomed to use some of the varied products of coal tar, most of which have originated in and are solely produced by Germany, are in a quandry to know what they can do if the source of supply is entirely shut off.

"It is of particular interest to note, moreover, that the manufacturers of England, Germany's great commercial rival, and present enemy, are almost as badly hit as those of the United States by the cutting off of the supply of German products. Our English exchanges reveal that while English manufacturers are making large plans for capturing the export trade in many lands which Germany cannot now reach, they find themselves handicapped at every turn by the cutting off of supplies which they themselves have been accustomed to obtain from Germany.

"Fortunately, the war has not yet closed all the avenues by which Germany can send out its product to the world. Through Holland, a neutral nation, shipments from Germany can reach tidewater and be distributed by neutral vessels.

"Of course, the drafts on Germany's male population for the army have paralyzed a large part of Germany's industrial activity, but since an underlying motive of the war is the maintenance of the nation's commercial prestige, it cannot be doubted that Germany will use every effort to continue to supply her foreign customers, so long as any channels for the outlet of her exports remain open."

Rebuilding the Pitt River Bridge

DOUBLE-TRACKING the lines east from Vancouver has necessitated the rebuilding of all the C. P. R. bridges. The largest of these in British Columbia, the one crossing the Pitt River, located about twenty miles from Vancouver, was the most difficult one to construct. Pitt River is about ten miles long and is the outlet of Pitt Lake into the Fraser River. The C. P. R. crosses it about one mile above its confluence with the Fraser, and the river at this point is about 1,800 ft. wide.

The old bridge consisted of seven fixed spans and one drawspan, and about 600 ft. of pile trestle. When the piers for the old bridge were built, the river scoured out a great deal and consequently an unusual amount of heavy riprap was required both in the river bottom and around the piers. This was a very serious drawback in the sinking of the new piers, especially with the open caissons which were dredged down.

The new bridge will consist of eight 80 ft. plate girder spans; one 279 ft. drawspan; two 257 ft. and one 182 ft. trusses, totalling 1,750 ft. between ballast walls. This required the construction of thirteen piers and two abutments. The two abutments and nine piers were constructed by sheet pile cofferdams and the four channel piers by the open dredging caisson method.

Preparatory to the construction of the piers, inasmuch as traffic had to be maintained, a short diversion trestle was built from the east side out to the end of the old swing span. This gave access to the east abutment and five piers. Later a continuation of the diversion trestle built 155 ft. downstream form the old bridge, allowed the construction of the remaining piers in the deeper part of the river. Owing to the large amount of river traffic, a temporary drawspan had to be erected in the downstream trestle.

Beginning on the west bank, piers were numbered one to thirteen on the extreme east bank of the river. Piers Nos. 2, 3, 4 and 5 were the most difficult to build. At the site of these piers there were respectively 45 ft., 65 ft., 65 ft. and 35 ft. of water at extreme low tide, with a 4 ft. tide and a 4-mile current to contend with.

The open dredging caissons for piers Nos. 2, 3 and 4 were of the same general type and were 35 ft. x 75 ft. outside dimensions with two 17 ft. x 20 ft. dredging wells. The solid timber crib was built up to 65 ft. above the cutting edge and the inner cofferdam carried up above high water level, and afterwards the top fifteen courses were taken off. Pier No. 4, typical of the three large dredging piers, was carried 36.7 ft. below the river bottom, 93.7 ft. below average high water. The total height of the pier was 105 ft. 11¼ in. These caissons were built up of 3-ply of 3-in. planks, the two outside layers being placed diagonally and the inner layer vertically. Each layer was spiked to the one adjacent and all were securely bolted to the heavy framework within. The outer walls of the caisson were shod at the bottom with steel cutting edges for protection in sinking through the bed of the river. The caissons were built up to a height of 12 ft. on shore and caulked. They weighed approximately 250 tons before launching and had a draft of 8 ft. when towed in position ready to commence building up and sinking.

Between the walls of the dredging wells and the outsides of the caissons, concrete was carried up to a height of about 20 ft. and from that point was filled with mud to get sufficient weight for sinking.

The caisson for pier No. 5 was quite different from caissons No. 2, 3 and 4, in that it was of reinforced concrete type rather than timber. The walls were 6 ft. thick including the timber crib work which acted as forms for the walls. The pier was octagonal 37 ft. x 60 ft. over all with corners cut off 45 deg.—11 ft. off the end and side. This left an area inside of approximately 25 ft. x 40 ft. which was divided lengthwise by a 4 ft. wall extending from about 2 ft. above the outside cutting edge to the top of the caisson. This division made two large dredging wells 20 ft. x 25 ft. in either end. This caisson was very heavy and sinking progressed very satisfactorily. When the caisson had reached an elevation of 14 ft., or 40 ft. below the old river bottom, a concrete seal 18 ft. thick was deposited through a tremie. From the top of this seal a four-foot wall was built dividing the two dredging wells in either end into two equal parts. This wall was carried to elevation 67.79 ft. or about 15 ft. below low

C. P. R. Pitt River Bridge. Sinking Caissons.

tide. The water was then pumped out and a temporary timber deck was put in at this point and a heavily reinforced concrete slab constructed, and on this the main shaft was built. The finished shaft of the pier being 30 ft. x 50 ft. over-all dimensions, four large cores were left in the four quadrants symmetrically with the larger cores in the body of the pier below, the idea being to diminish the dead load going directly on the slab and to effect a saving in the quantity of concrete.

The anchoring of the dredging caissons Nos. 2, 3, and 4 was a rather difficult proposition on account of the depth of water and a current to contend with both ways, as the tide moved against the current of the river and with the current of the river at about the same velocity. This anchorage was composed of eight sets of 1¼-in. galvanized cables, two on each corner, one set about 30 ft. above the cutting edge and the other 20 ft. above this. Upstream the cables were anchored 400 ft. to three Chinese anchors. These Chinese anchors, or cribs, were located so as to provide anchorage for all three caissons. Downstream the tackle was fastened to dolphins driven about 300 ft. below the old bridge. The handling of this tackle during the building up and sinking of the cribs required a great deal of skilful diver work as the deep water and the current made it very difficult for a diver to work rapidly and with safety.

In the case of pier No. 5, the water not being so deep and it being necessary to protect the caisson from river traffic, a pile fender was constructed entirely around the pier, very thoroughly braced and tied together after the caisson was floated in. This fender provided an excellent platform to work from and facilitated the dredging a great deal inasmuch as it served as a guide in sinking.

The location of pier No. 5 came directly upon the site of pier No. 7 of the old bridge and on this account about three hundred old piles had to be pulled before the caisson could be put in position on the river bottom. This was an extremely difficult job, as the majority of them extended only a foot or so above the river bottom and the tackle had to be put on the same by a diver.

East and west abutments and piers Nos. 1, 6, 7, 8, 9, 10, 11, 12 and 13, were all built by sheet pile cofferdam method. In some cases T. & G. sheeting was used; in others squared timber with splines was used. As the cofferdams were all located in that portion of the old bridge which was pile trestle, there was a large accumulation of sunken logs, branches and roots which had to be contended with in driving the sheeting for the cofferdams, and also in the excavation of the material before and after driving the round piles on which the pier was built.

All piers with the exception of No. 6 were practically the same size and in general the cofferdams for same were 22 ft. 6 in. x 47 ft. Pier No. 6, this being the east draw rest, was 22 ft. 6 in. x 56 ft. The usual method of building cofferdams was used and with the site of the pier cleared, inside and outside rangers sunk and sheeting driven. After this the excavation in some cases was made by dredging or with hydraulic excavators. The piles were driven with both steam hammers and drop hammers. The driving in all cases proved difficult on account of compact sand being encountered. In most cases a 4 ft. seal of concrete was placed by tremie and the cofferdam unwatered. On this seal the footing courses were placed and the shaft of the pier built, all in the dry.

In the case of pier No. 6, a large number of piles had to be pulled here as it coincided with the site of

Caisson No. 5 on the ways.

Caisson No. 5 built up 50 ft.

old pier No. 9. After the site had been thoroughly cleaned, however, the remainder of the work was practically the same as with the other cofferdams.

Owing to the two distinct methods of construction employed and the fact that the operations were carried on simultaneously, a large amount of plant was required. On the east side one mixer plant, centrally located, mixed all the concrete for piers No. 6 to the east abutment, inclusive. Concrete was handled by Lakewood bottom dump buckets mounted on cars and operated along the old bridge by an endless cable haulage. For concreting piers Nos. 2, 3, 4 and 5, a floating mixer plant equipped with a derrick, sand and gravel hoppers, cement house, mixer, and 60 ft. elevator tower equipped with an Insley hoist and hopper, was used. Both mixers were the 1-yd. Ransome type. Two steam plants were installed, one on either end of the bridge. On the east side where the number of cofferdams required a large amount of pumping, a 300 h.p. steam plant was installed and on the west side approximately 200 h.p. for handling the pumping at that end. All told, there were 5 centrifugal pumps and 4 sinking pumps. Seven stiff leg derricks and 4 combined stiff leg and guy derricks were used handled by two 3-drum engine and nine 2-drum hoisting engines, together with swinging engines and Hayward two-in-one machines. In addition to the above, two diving outfits were used; two Monarch steam hammers; one Vulcan steam hammer; two drop hammers; two orange peel buckets and four clam shell buckets, and a large number of push cars, side dump dirt buckets, and concrete buckets.

Some of the quantities involved in the contract are as follows:—21,000 yards of concrete; 3,750,000 feet of timber; 40,000 yards excavation; 43,000 lin. ft. of foundation piles; 30,000 lin. ft. of round piling for temporary work.

Work was started in December, 1912, and completed in March, 1914, by The Foundation Company, Limited, Montreal and Vancouver, under the direction of Mr. H. Rindal, Division Engineer for the Canadian Pacific Railway, Vancouver.

Lock Gate Lifter for Trent Canal

THE accompanying illustrations show the steel Pontoon Lock Gate Lifter which was recently built for the Department of Railways and Canals for service on the Trent Canal by Messrs. M. Beatty & Sons, Limited, of Welland. It was designed and built to lift and place into position the lock gates, and its capacity of 50 tons and clearance of 37 feet above the deck will enable it to stop any of the mitred gates throughout the entire length of the Trent Canal. The general design comprises a structural steel collapsible derrick mounted on a steel pontoon, with separate steam engines for each operation.

The pontoon supporting the derrick is made of steel plating with extra strong steel frame work, there being two longitudinal and three transverse trusses, so as to provide for the severe loads it will have to bear. The hull is constructed with rounded bilges and each end has a rake of 45 degrees. The length is 55 feet, beam 27½ feet, and depth 9 feet.

The derrick is built of structural steel in two units. When in working position, the derrick is erect as shown in Fig. 1. In transporting the lifter from one lock to another, the upper part of derrick is lowered where necessary as in Fig. 2. This allows of its passage under overhead bridges along the canal. The operation of raising and lowering the derrick is performed by a 6 by 6 double cylinder engine mounted on one of the back legs. Two swivel hook padlocks are suspended, one from each overhanging top of the front legs of the derrick, each carrying 8 parts of ⅞-inch steel cable.

The main engine has 9 by 9 double cylinders, double drums and is link reverse. The operating levers are brought to one position for the convenience of the engineer.

The pontoon is kept on an even keel by two moveable ballast cars under deck. Each car is moved by a steel screw operated by independent 6 by 6 reversing engine. These engines are controlled by pendulum governors, automatically shifting the ballast to the proper position to put the pontoon on an even keel, whether it is under load or light, with the derrick upright or folded. In addition to the automatic control, the ballast car engines can be operated from the engine room above deck. Dial indicators are provided to show the position of the ballast cars at all times.

The machine has stepped to date the gates for Locks No. 1, 2, 3, 4, 5 and 6 of the Ontario-Rice Lake Division of the Trent Canal and in operation has met all expectations. The total time for stepping each leaf from picking up in water to releasing in gate recess varied from twenty to forty minutes, according

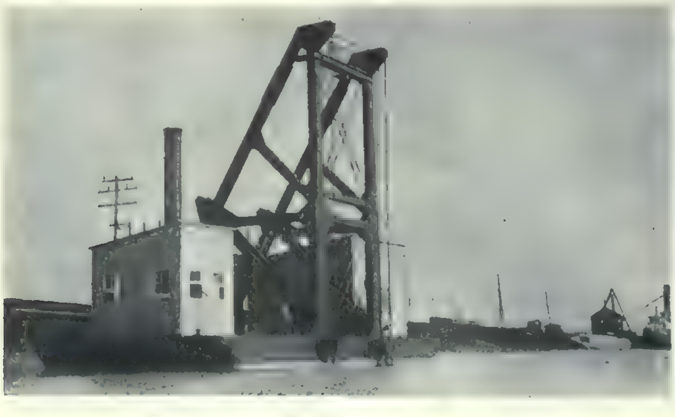


Fig. 1.—Gate lifter just after completion. Top of derrick raised.

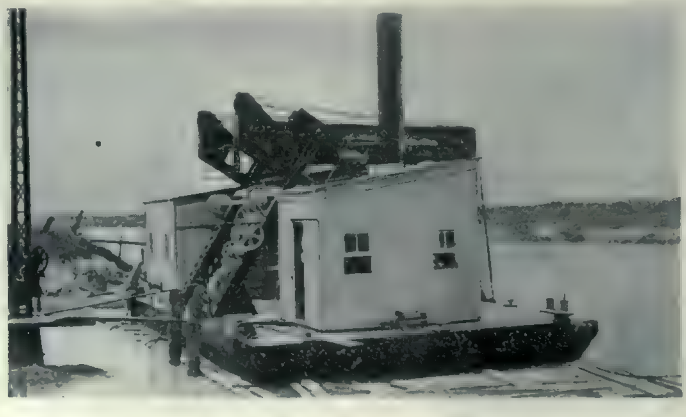


Fig. 2.—Gate lifter with top of derrick lowered for passing under overhead bridges.

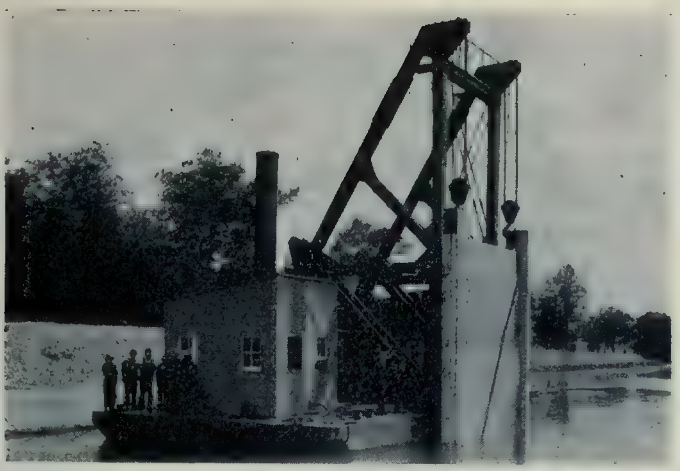


Fig. 3.—Gate leaf at lock No. 4 being raised by the steel pontoon gate lifter.

as an upper or lower gate leaf was handled respectively. At Lock No. 3 the lower gates are 37 feet high over timbers and these represent the heaviest gates the Lifter is designed to handle.

Rebuilding a Bridge Five Hundred Years Old

THE recent rebuilding of the Notre Dame Bridge in Paris is a notable circumstance in that it brings up to the twentieth century an engineering structure that was first put in service more than 500 years ago, and has since been rebuilt only three times, although in constant use. The present work, which is described by the Engineering Record, is an example of progressive American methods and materials adopted in conservative European practice. It involved the removal of three short-span masonry arches in the centre of the channel and the building in their place of a single plate-girder arch span erected on falsework trusses, the reinforcement of two pier shafts and their footings to resist the unbalanced thrust after the removal of the short spans and after the construction of the long span, and the widening of the old arch spans at the ends of the bridge. Bridge traffic and navigation were maintained throughout the construction. The old foundations were retained and enlarged and the serious obstructions offered by the centre piers will be entirely removed, thus greatly improving navigation.

The Notre Dame Bridge across the Seine is a historic structure first built about the year 1400. It was destroyed by a flood in 1499, and was immediately replaced by a structure which endured until 1852, when a new superstructure was built on the old foundations. The piers were not quite parallel to the axis of the river, and constituted a serious obstruction to navigation and caused numerous accidents. The bridge had five cut-stone arches of about 57, 61 and 62-ft. spans and a width of 71 ft. over all.

Alternative plans of reconstruction were considered, one of them involving a new centre span of 284 ft. and the other a new span of 197 ft., retaining the two end arches. As the respective estimates of cost for these plans were about $252,000 and $157,000, and as the vertical clearance was inadequate for a satisfactory rise for the long-span arch, the second plan was adopted, and is now in an advanced stage of execution.

The new span has eight riveted plate-girder arch ribs, spaced about 8 ft. apart on centres, except the outer ribs, which are about 13 ft. from the next ones. The depth of the ribs varies from about 2.6 ft. at the crown to 3.9 ft. at the skewbacks, and the centre line is a segment of a circle of 256 ft. radius, which gives a rise of about 20 ft. The ribs are connected by transverse lattice girders in radial planes. These girders have the same depth as the arch ribs at the point of intersection, and are spaced about 10 ft. apart. Vertical posts, also spaced about 10 ft., carry longitudinal and transverse girders supporting the 4 x 5-ft. buckle-plates. Wood block pavement is used except under the electric car tracks, where the concrete floor has an invert-shape cross-section supported on concave steel plates, affording clearance for the electric conduits. The outside girders are masked by cast-iron molded fascia bolted to them and joined at the crown to molded cast-iron cornice pieces.

The ends of the arch ribs are provided with cast-steel shoes in radial planes, and corresponding cast-steel pedestals are anchored to the masonry. Both shoes and pedestals are recessed to receive three full-length horizontal transverse keys with a rectangular cross-section, convex on the side toward the arch ribs, in which they have concave bearings. The keys are adjustable by shims on the skewback sides. The centre keys were first inserted, and the ribs erected with them acted as two-hinge arches under dead load only. After the erection was completed and all of the dead load imposed, the other two keys, above and below the centre keys, were inserted and adjusted to positive bearings, thus transforming the ribs to fixed-end arches under live load.

Reinforcing Piers and Removing Arches

Piers 1 and 4, carrying the river ends of the end spans, were originally proportioned for balanced loads from the nearly equal adjacent spans they supported. When the balance was disturbed, first, by the removal of the river spans and, afterward, by erecting the long new steel span, their sections became inadequate for the unbalanced stresses developed. They were therefore reinforced by extensions 10 ft. wide on both sides and by increasing the width and height of their shafts. The piers were inclosed by a cofferdam of Carnegie steel sheet piles 36 ft. wide. The interior of the cofferdam was excavated to the bottom of the old stone footing and was filled nearly up to low-water level, with concrete thoroughly anchored to the old masonry.

The three centre arches between these reinforced piers were wedged on falsework centres seated on timbers transverse to the axis of the bridge. They were supported on inclined posts seated on the old pier footings below water level and had their over-hanging tops tied together by longitudinal horizontal rails on both sides of the bridge. This arrangement left nearly all of the space between the piers at water level unobstructed for navigation and permitted the removal of the old arches and piers down to the skewbacks. Subsequently the two centre piers were removed, after having served for the support of the falsework for the erection of the new span.

The faces of the reinforced piers were racked off above the new footings and new stone-faced concrete was built over and around them, forming shafts reaching to roadway level between the new span and the old end spans. New cutwaters were built on the ends of the reinforced piers and both faces of the end spans were extended by new arch rings built out to give this portion of the bridge the same width as that of the new span.

Cantilever brackets were built on one side of the bridge to carry the sidewalk temporarily, the vehicular and car traffic was confined to a narrow adjacent strip of the old structure, and the remainder of the three old arch spans was removed in one longitudinal strip having a width greater than one-half of the original width of the bridge. Afterward six wooden falsework trusses were set on the old piers in the panels between the new arch ribs, and the latter were erected on them by an overhead gantry traveller. Some of the vertical posts of the framework trusses extended below the bottom flanges of the arch rib to carry a working platform below and parallel to the latter.

After the completion of the longitudinal section of the new arch, traffic was transferred to it, the remainder of the three old arches removed, and the balance of the new span built. The two old centre piers are now being removed. The total cost of the reconstruction of the bridge is about $273,000.

Glass-Faced Bricks

GLASS-faced bricks with concrete backings have appeared on the market. They are said to be equal to any form of tile or glazed brick as a lining for tunnels, swimming pools or bath-rooms; as well as for the inside walls of garages, engine houses, prisons, meat-markets and other structures where perfect cleanliness is as desirable as it is difficult. They are heat and cold resisting, and are declared to be everlasting, requiring no paint or other treatment to preserve their appearance. For shops and factories the concrete-backed glass brick would seem almost an ideal material. The construction of the brick is as follows: To a glass facing ¼-inch thick at its thinnest part is attached a well proportioned concrete back. The concrete backing is attached to the glass front by three separate means, each entirely sufficient to secure the union of the two materials. First, the cement on the concrete adheres to the glass; second, both ends of the glass face are returned by greater than a right angle, thus imprisoning the concrete mass; third, a dove-tailed rib of glass traverses the entire length of the back of the facing, at once strengthening the glass face and also securing it to the concrete body. The glass face is 1/16 of an inch larger all around than the concrete body, thus making possible a good mortar bond, notwithstanding that the mortar between the faces of the glass may be almost entirely pressed out. The new bricks are laid in exactly the same manner as other finished bricks.

The Salvage of Road Hauling Machinery

A FEW years ago the cost of hauling over country roads, was thought to be well established for ordinary conditions, comments Engineering and Contracting, editorially. Accurate cost data collected under many varying conditions established a reasonably accurate ton-mile estimating cost of hauling with teams; accepted for earth roads as varying between 20 and 30 cents. New developments in machinery have, however, placed at the disposal of the road contractor and superintendent other methods of hauling which, under proper conditions, are more economical than team hauling. The steam and gasoline tractor with wagon train, the motor truck alone or with trailers, and the industrial railway, each have a definite field in which their use results in a saving over any other method that might be employed.

It is not our purpose to discuss these methods of hauling or their limitations. Indeed, any but a very general discussion is valueless unless applied to a particular problem. Moreover, each construction problem is a study in itself and similar conditions do not recur with any great degree of frequency. A single factor introduced in the problem may change plant requirements completely. For example, an unusually large amount of shallow earth excavation might call for so many teams that team hauling of materials would be most profitable. Or, vice versa, a large brick or concrete construction job with light grading would be handled most economically by the use of mechanical hauling equipment.

Experience has demonstrated that under most conditions the use of machinery results in lower hauling costs and a saving in time. There exists, however, one serious drawback to its more universal use. The first cost and depreciation of mechanical hauling equipment is greater than that of teams and the salvage value is proportionately less, not only in the actual cash but in readiness of market. What causes contribute to this condition and how may the condition be remedied? First cost is of small moment if the output is increased and a ready salvage market established. Depreciation is a definite factor to consider in first cost. Manifestly the problem turns on the question of plant salvage.

Probably the most serious danger that confronts the modern road contractor is that of over equipment. Plant suitable for most economical results in road building is available but it is expensive and a large amount is required. The amount of capital invested in plant that must remain idle, from the character of the work, for a portion of the year is large. Unless this plant can be disposed of at a reasonable price upon the completion of the work, profits are tied up in equipment that may be of small value on the next work undertaken, or may become obsolete.

To alleviate this condition as well as to promote sales many reliable machinery manufacturers have established service departments and will redeem used machinery. The principle of this plan is excellent. Second hand machinery is, undoubtedly, worth more to the manufacturer than to anyone else. When rebuilt it is practically as good as new and, in the case of well standardized machines, sometimes better. One manufacturer of automobiles, noted for the profitableness of his business, has a definite policy of replacement, allowing a substantial value for old machines. This practice is of great assistance to contractors and should be developed. The proper salvage of plant used in road haulage is by no means a new idea, but the importance of its consideration with reference to hauling equipment will become more apparent with the increased use of machinery for this work which will undoubtedly come in the next few years.

It is false patriotism and false economy to contribute to relief funds with one hand and pay off or unnecessarily reduce one's establishment with the other. Our duty is not so much to provide for anticipated distress, as to take steps to prevent it by maintaining normal conditions to the utmost of our resources.

A clean, sharp, thoroughly dried silica sand or crushed quartz should be used for sandblasting. For use with a ¼-in. nozzle the sand should be screened through a No. 8 screen, and through a No. 12 when a ⅛-in. nozzle is used.

Pile drivers of the Toronto Harbor Commissioners' plant constructing retaining wall on the North Slip.

Progress of Toronto's Twenty-Five Million Dollar Harbor Development

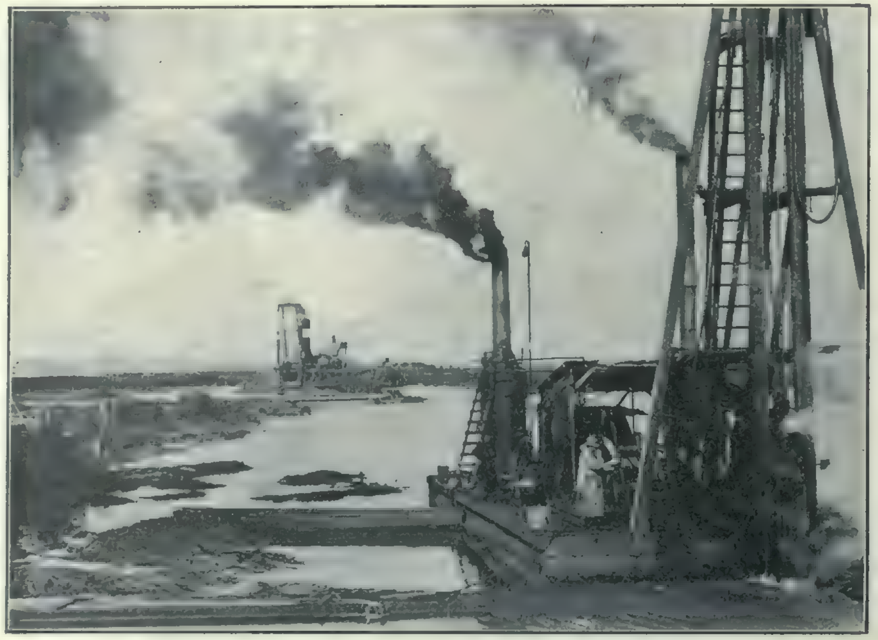
Of the many important engineering enterprises with which Canada is associated, one of the most important, from the viewpoints of both magnitude and financial outlay, is the harbor development work now under way at Toronto. The Contract Record of November 20-27, 1912, contained a comprehensive description of the scheme. In this issue further details, together with particulars concerning the actual work, are given in the form of a progress report. Operations were commenced early in the present year, and the extent of the scheme will be realized when it is stated that eight to ten years will be required to complete the undertaking and that the total expenditure will be approximately $25,000,000. The project is easily the largest of its kind on the American continent.

An important portion of the development work is undertaken by the Dominion Government and this work is at present under contract. This includes the construction of the western breakwater, the ship channel and turning basin in the industrial section, the retaining wall and the northern slip. Reclamation work for the industrial district was started last spring by the contractors whose dredges have already performed extensive filling operations. Piling has also been proceeding with marked rapidity during the summer.

For the purpose of reference it will be necessary to state that the work is divided into three sections comprising the eastern, to the east of the Eastern channel, the central, lying between the two channels, and the western section, to the west of the Western channel.

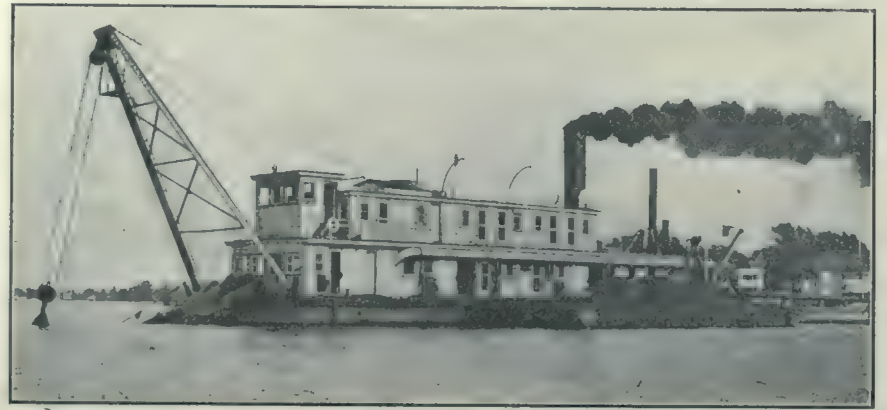
In the eastern section the development planned covers three phases—commercial and dock development, industrial development and park treatment on the lake front. A breakwater 4¼ miles long, extending from the Humber to the western entrance of the Western channel, will be constructed at an average distance at some points out in the lake of 700 feet from the present shore line. About four miles of retention piling and dock work, including ship channel, turning basin and marginal way on the bay face and northern slip, constitutes part of the work on the eastern section. On the latter section a sea wall and

Toronto Harbor Commissioners' hydraulic dredge deepening the harbor and adding land to the Island.

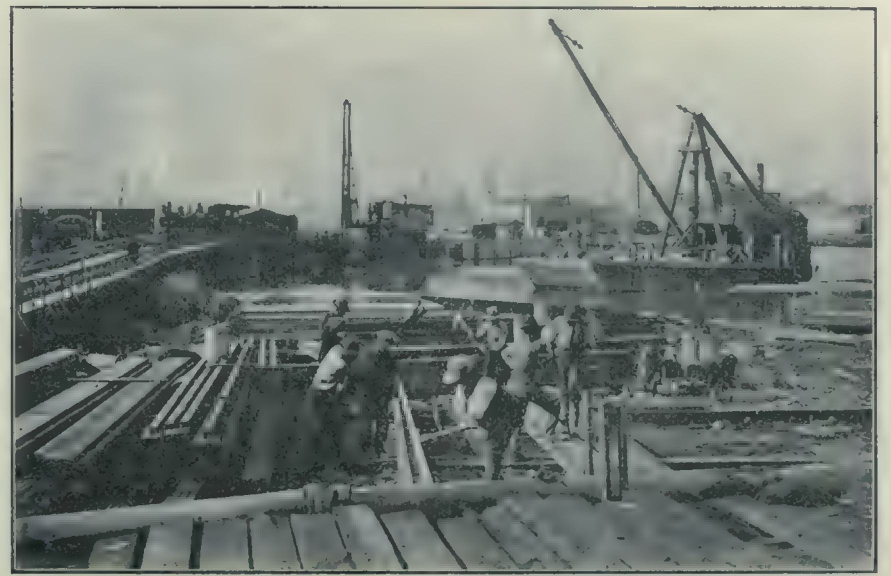


Commencing the construction of the big ship channel.

Stock of piles for harbor improvement work.



Hydraulic dredge No. 3 in action.



Preparing sheet piling for the North Slip retaining walls.

Toronto's Great Harbor Development Scheme

composite pile protection work, 19,000 ft. long, will be erected. Similar work on the western section will be 20,000 ft. long, and a retaining wall 6,880 ft. long, from Sunnyside to the Humber and an exhibition dock, 300 ft. in length, are also included in the scheme. In the western section there will be one 400-ft. concrete arch pedestrian bridge connecting the mainland with the exhibition dock. This bridge will be 16 ft. wide and will have about 70-ft. arch spans.

Provision for trolley, vehicular and pedestrian traffic across the eastern and western channels will take the form of steel bridges of the Bascule type, 70 ft. wide. The type of bridge for the crossing of the ship channel will also be 70 ft. wide, and will provide for the steam railway in addition to other modes of traffic. The original channel of the Don has been preserved, and what is known as Keating's Cut has been developed from the Don to the Humber. It is proposed to erect a bridge with span of 120 ft. across the northern slip at the foot of Cherry street. This bridge will be the Bascule lift type, about 60 ft. in width.

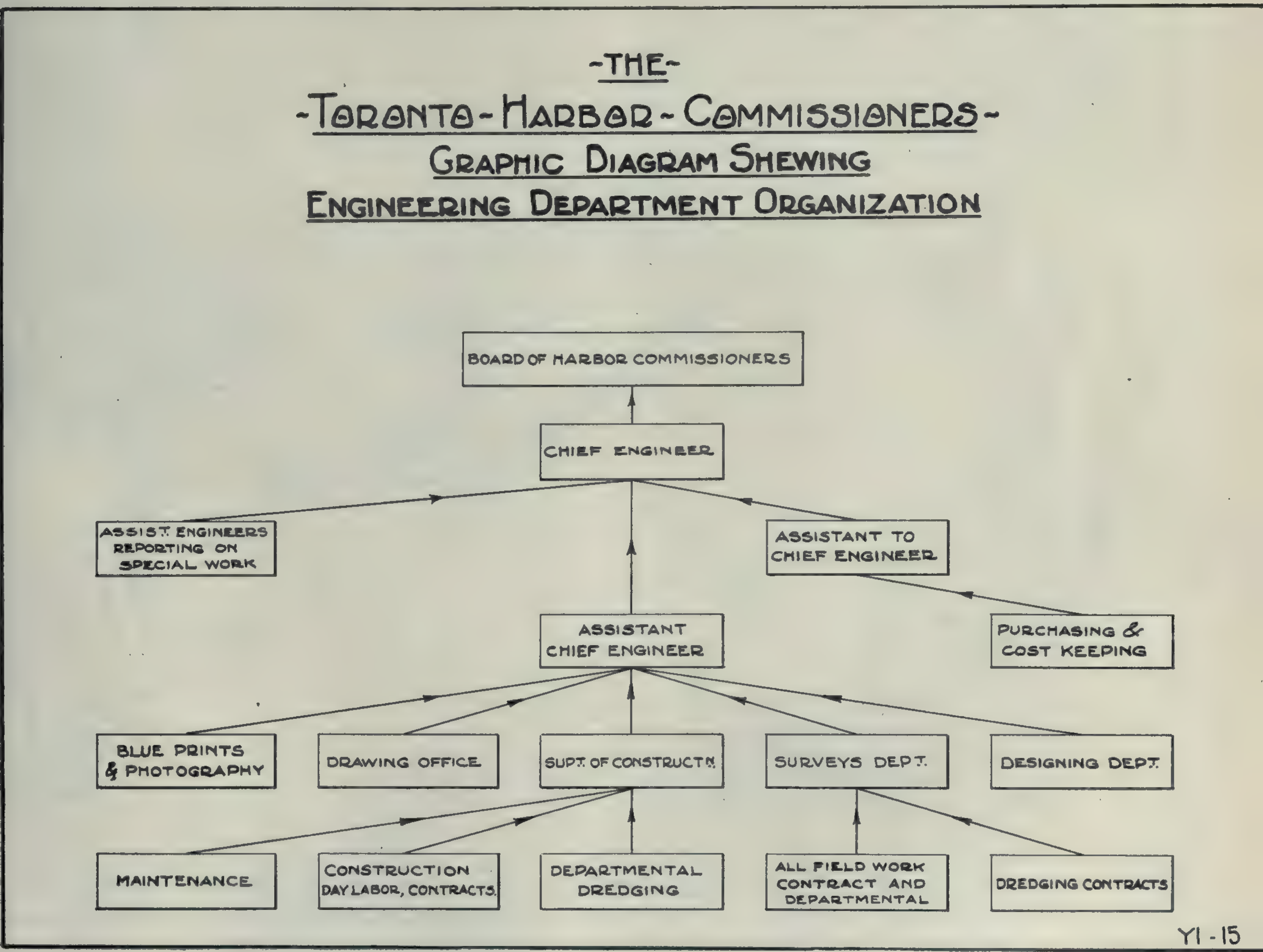
In the eastern section, on the boulevard drive, provision will be made for seven vehicular bridges with a 40-ft. span and 56 ft. wide, two similar bridges each with 100-ft. span and a width of 56 ft. For crossing lagoons several foot bridges of arch construction and approximately 50-ft. span, will be erected.

Over the central section a number of 50-ft. bridges of the arch type, and 10 ft. wide, will be provided. These will provide for street railway, vehicular and pedestrian traffic.

The Ship Channel

A ship channel will be constructed for the purpose of extending the inner harbor into the new industrial district. This channel will be 6,800 feet long, 400 feet wide and 24 feet deep with provision for future deepening to the extent of 30 feet. The channel will terminate in a turning basin 1,100 feet square and the sides of both the channel and turning basin will be so constructed as to form three miles of dockage accommodation. The sea wall, breakwater and filling work is expected to take about five years to complete. The industrial area, when completed, will contain 644 acres of land for factory sites, 235 acres of streets and railroad reservations, and 138 acres of waterways. The central or bay phase of the district will be developed for dock purposes as the district grows and will ultimately add an additional 2½ miles to the dock frontage of the bay.

The area north of the ship channel will be reserved for the location of light manufacturing plants. The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GRAPHIC DIAGRAM SHEWING
ENGINEERING DEPARTMENT ORGANIZATION
BOARD OF HARBOR COMMISSIONERS
CHIEF ENGINEER
ASSIST. ENGINEERS REPORTING ON SPECIAL WORK
ASSISTANT TO CHIEF ENGINEER
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area to the east will accommodate heavier plants which do not require direct water service, and the area south of the channel will be utilized for manufacturing plants of the heavier type, requiring a frontage direct on navigable water.

Constructional Features

The amount of sheet piling required will total about 19,000,000 feet. British Columbia fir is used throughout for this work, and for round bearing piles, of which about two million lineal feet will be utilized, timber of various kinds suitable for such work is adopted. In the construction of the ship channel forty-ft. sheet bearing piles will be driven. The superstructure will be composed of concrete blocks to above water level, with massed concrete on top to an elevation of six feet above datum, which latter is established at 245 feet above mean sea level at New York.

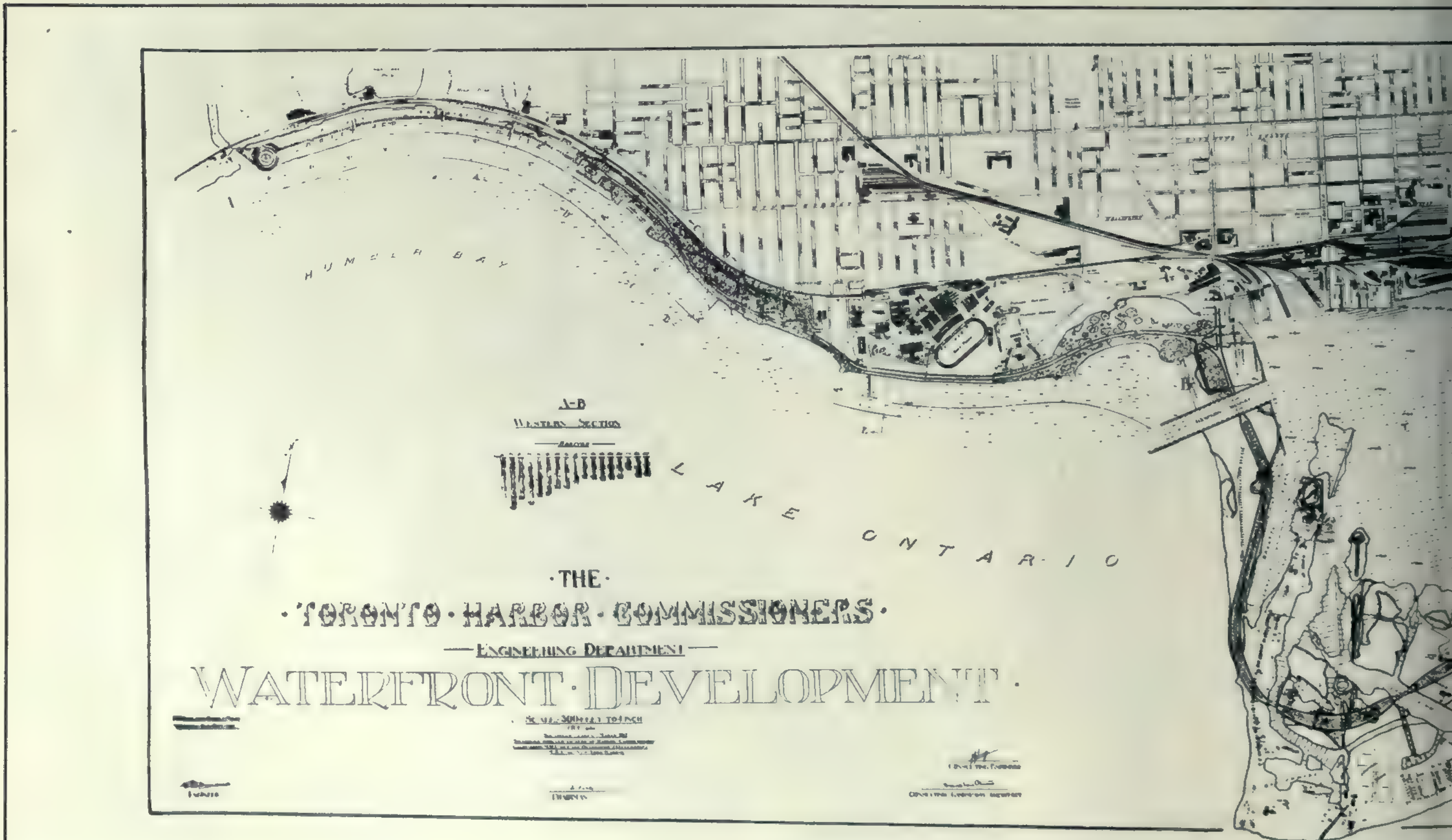
The construction of the cribs will be an important part of the work, due partly to the engineering difficulties involved. They will be standard cribs with stone fill and concrete tops, the crib work extending for about 4¼ miles. These cribs will be sunk in 100-ft. sections, each section being about sixteen feet wide and fifteen feet deep. About 40,000 cu. yds. of concrete will be placed in the western breakwater, the ship channel and turning basin absorbing about 42,000. In the construction of the sea wall about 33,000 feet of concrete will be used and the balance will be distributed more or less between the marginal way and the northern slip. The general contractors for this work undertaken by the Dominion Government are the Canadian Stewart Company, Limited, Toronto, the contract price amounting to approximately $5,400,000. In laying all concrete in water the block system has been established throughout. This consists of moulded blocks set in position on a superstructure.

The reclamation work at Ashbridge Bay is being carried out by the Harbor Commission. This will provide 600 to 700 acres of reclaimed space for the provision of factory sites. Plans are in preparation by the Harbor Commission engineers for a section of the buildings to be erected upon the marginal way. These buildings will be of reinforced concrete construction and will be leased for industrial purposes. When reclamation work is completed almost 650 acres will be available for factory sites. In the matter of transportation facilities this industrial district will be served by three transcontinental railways. The contract for this reclamation work, which is also being carried through by the Canadian Stewart Company, amounts to about $6,000,000.

Waterfront Development

The development of the water front of the inner harbor will be of outstanding importance. This section of the work will be developed as necessity demands. The plans provide for a new set of docks to replace the present piers which are becoming inadequate for the city's water-going commerce. This part of the scheme will involve considerable land filling, besides the construction of a new thoroughfare along the harbor. Piling has been completed in this section. At present the contractors have under construction two large dredges, each of which will have a daily average capacity of about 16,000 cu. yds. The other plant in operation consists mainly of standard pile drivers, steam hammers, cut-off saws, etc., suitable to the character of the work in hand.

The western section will be developed solely for



General plan of the extensive development now being carried out b park and recreation purposes. The breakwater will not only protect the shore from storms but will also provide a sheltered waterway, 500 feet wide on the average, for small craft. In this section it is anticipated that about 190 acres of new land will be made. The scheme has been worked out under the general direction of the Toronto Harbor Commission.

The engineering work is in charge of Mr. E. L. Cousins, Chief Engineer, Toronto Harbor Commission. Mr. J. R. Wainwright is assistant chief engineer, and Mr. D. Molitor, designing engineer.

The war has made little difference to the big constructive works of the Government. Operations have been continued without cessation on the Welland Canal, the Hudson Bay Railway, the work at Port Nelson and the Halifax harbor scheme. Provided money conditions remain reasonably easy, this work will be prosecuted steadily throughout the war. Nothing new will be undertaken, however, and the programme of public works such as, in the usual course, would be proposed for the approval of Parliament next session, will be cut in half. Only work which has already been commenced or is absolutely necessary will be carried on. In this way the Government hopes to be able to give employment to many while at the same time practising that economy which the present situation demands. The Georgian Bay Canal Investigation Commission, it is understood, has practically ceased work. There is no doubt that this great project will be held in abeyance by the war. The Commission will continue in existence but its work will experience a temporary cessation as a result of the war.

Economy of Concrete Bridges*

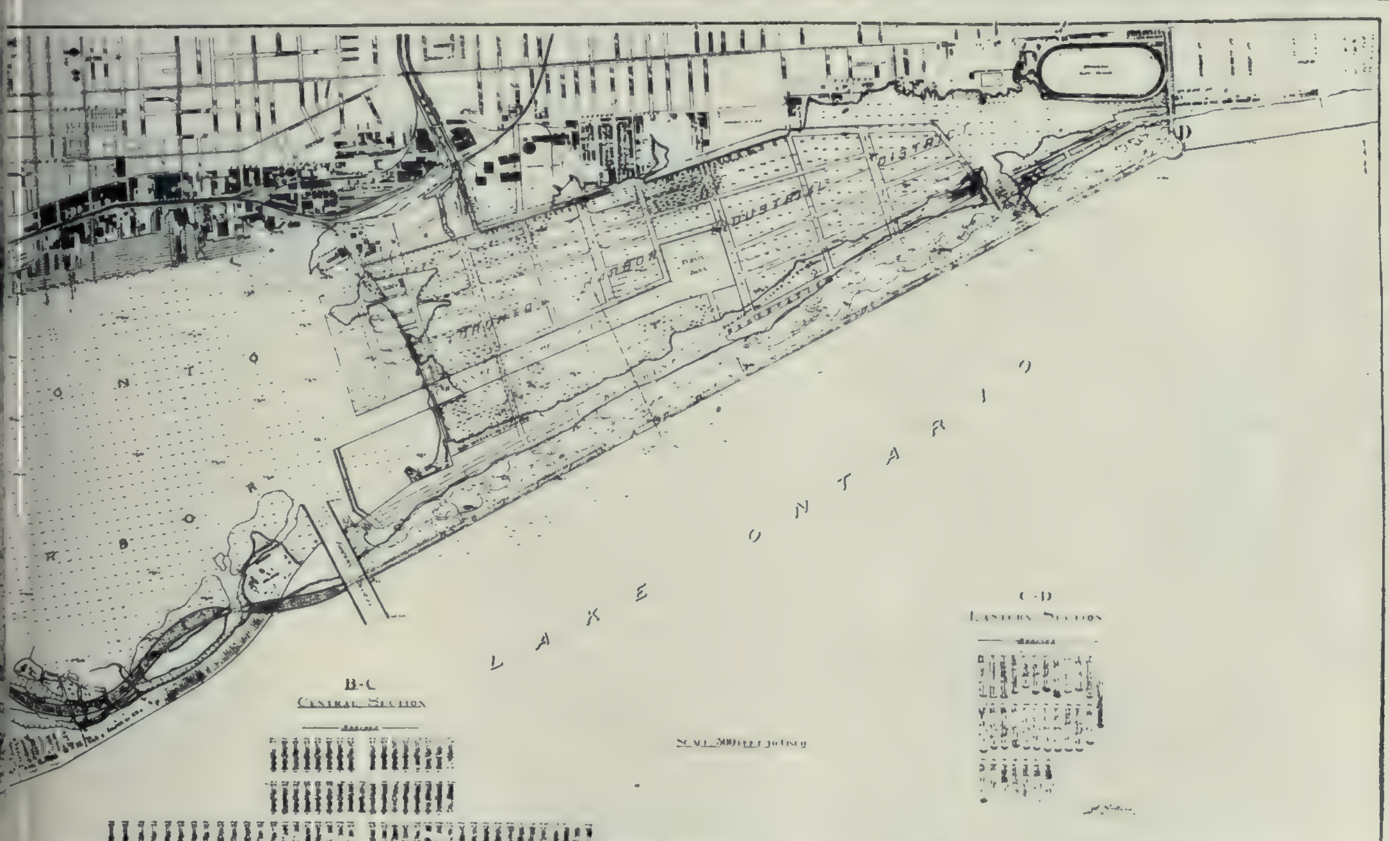
By Daniel B. Luten

It can easily be shown that it is no longer economical to build temporary bridges of wood or steel except for unusual locations and conditions. Assume, for example, that a 50-ft. bridge of a temporary character costs $1,000, and that the amount is borrowed at 5 per cent. interest. Assume also that the life of the bridge will be 25 years—the average life of a steel highway bridge—and that the bridge will require re-flooring at intervals of five years, and re-painting at intervals of eight years. Then, for the 25 years, the maintenance cost will be as follows:

Interest charge, 25 years at $ 50.00	$1,250.00
Re-flooring four times, at $100.00	400.00
Re-painting twice at $50.00	100.00
Maintenance for 25 years	$1,750.00

This is at the rate of $70 per year. The original loan of $1,000 still remains unpaid, but an additional loan of $1,000 must be made to replace the bridge. Hence, for the next 25 years, the maintenance will be increased by the interest on the second note, making $120 a year. For the third 25 years, the cost will reach $170 a year, with $3,000 borrowed; and at the end of a century the maintenance will be $270 a year, with $5,000 owing on notes.

If, instead, a permanent bridge has been built, all of the maintenance for the first 25 years might have been expended for interest, making a loan of $1,400 possible at the same cost per year, and this would never need to be increased. That is to say, it would



ronto Harbor Commissioners at a cost of twenty-five million dollars.

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* Extract from an address before the Kansas Engineering Society.

be economy, even for the first 25 years, to pay 40 per cent. more for a permanent bridge. And, if a sinking fund were established to meet the notes at the end of each 25 years, about $26 per year additional would be required, making the maintenance charge $96 per year, which is the interest charge on $1,920. So that, under the above conditions, a permanent bridge would be worth 92 per cent. more than the temporary bridge above described.

New Type of Driver for Large Concrete Piles

A FLOATING pile driver of an unusual type, and more powerful than any previously built, has been used in building the new pier of the Intercolonial Railway at Halifax, N.S., and is described in the Engineering Record. Not only will the machine handle heavily reinforced concrete piles 24 ins. square and as long as 77 ft., but it will drive them in threes, one after another, without change of position, and will handle batter piles with equal facility.

The pier and shed are entirely of reinforced concrete. The pier is 800 ft. long and 235 ft. wide and is supported on 1,800 of the 24-in. concrete piles, which range in length from 57 to 77 ft., and are each reinforced with eight steel rods from 1 to 1¼ in. in diameter, according to the length of the pile. To get the piles down to rock they have to be driven through from 3 to 14 ft. of hardpan. The design calls for some of the piles to be driven in groups of two or three, side by side, with practically no space between them, and for diagonal piles battered 15 or 16 deg., driven close against the faces of the vertical piles in order to brace them.

A wood hull 108 ft. long, 45 ft. wide and 12 ft. deep at the bow carries the pile driver. In order to support the leader carriage tracks, there are solid timber bulkheads from bow to stern, and also several transverse trusses.

Carriage

The drums and machinery for handling the piles and operating the hammer are supported on a heavy structural-steel carriage, mounted on rollers which travel on a track, and the whole is moved by means of a rack-and-pinion drive. The front of the carriage is provided with two heavy girders. The upper girder carries a trunnion bearing, which supports the weight of the leaders, while on the lower girder is a specially designed crosshead attached to the leaders in such a way that they are held firmly. Trunnion bearing and crosshead are connected to independent screw shafts driven by an engine; hence simultaneous operation of both shafts will move the leaders laterally across the carriage, while operation of either shaft alone will swivel them. In this way a transverse motion of 8 ft. as well as a fore-and-aft play of 7 ft. is provided, and canting of the leads to take care of the batter piles is also made possible.

Two forward spuds, each provided with an independent engine, hold the driver in position when in action. The spud machinery, which is located well aft, is connected to the spuds by wire ropes and is controlled by levers within reach of the engineer from his position in the travelling leader carriage. There is a third spud at the stern.

At first it was thought that piles as long as 90 ft. would be required, and the length of the leaders was fixed to accommodate such piles. The leaders are, therefore, 76 ft. long over all, standing 70 ft. above the deck.

Hammer

The steam hammer is said to be the largest double-acting steam pile-driving hammer ever made. The combined weight of hammer, follower and follower guide is approximately 28,000 lbs. The cylinder is 14 ins. in diameter and of 36-in. stroke, and the weight of the ram alone is 4,000 lbs. With a mean effective steam pressure in the cylinder of 80 lbs. per square inch the hammer is rated to develop 3,916,000 ft.-lb. per minute when the hammer is striking eighty blows per minute.

In order to take care of the reinforcing bars, which project 3 ft. above the ends of the piles, the hammer is fitted with a special cap. The leaders are equipped with a special hammer track, by means of which the hammer when hoisted can be switched in out of the way of a swinging pile. An automatic locking device is provided at the top of the leaders to support the weight of the hammer while the pile is being placed in position, and there is also an intermediate stop to hold the hammer when the driver is not in use.

Scows deliver the piles to the driver, two derricks handling them. The machine was originally intended to drive one pile an hour, but has proved able to handle twenty or twenty-five in a ten-hour working day.

The pier was built by the Nova Scotia Construction Company, Limited, of Sydney, N.S., under the direction of Mr. John Kennedy, consulting engineer, of Montreal, and Mr. A. F. Dyer, his local representative. The Bucyrus Company, of South Milwaukee, Wis., designed and built the pile-driving machinery, collaborating with Mr. W. L. Scott, chief engineer of Mussens, Limited, of Montreal, who was consulted by the contractors and who designed the hull and the derricks. The Union Iron Works, of Hoboken, N.J., designed and built the steam hammer.

The record of C. P. R. work in connection with the Rogers Pass tunnel shows on the east side—pioneer heading—4,107 feet; main heading, 1,580 feet; west side, pioneer heading, 1,127 feet; main heading, 406 feet. This is considered to be good work when the extreme difficulties are considered. The men, some 700 of them, are working virtually in the clouds. They work and eat and sleep on the same level. The work proceeds through the solid rock. Pioneer tunnels are being built to enable the main tunnel to be tackled at several points. This is a work of uncommon magnitude. The point about it is that although the war has altered many things, this work, which is to cost $10,000,000, goes steadily on toward realization. It may be described as the most important work which the C. P. R. has presently on hand. Tunnel experts all over the world are interested in the progress of the work, which is unique in many respects, especially with regard to the high altitude.

Steel passenger cars for Indian railways are said to be under consideration by some of the railway companies, owing to the increasing price of teak wood and the decreasing price of steel. At present, steel freight cars are used extensively, and the modern passenger cars have steel underframes with wood bodies. In view of the intense and continued heat, special means of insulation and ventilation would be required for steel bodies of passenger cars.

Shoulders for Concrete Roads*

WITH the almost universal tendency in concrete road construction to keep the width of the concrete as low as practicable, in order to reduce the first cost (per mile) of the improvement of a road, has come, in many cases at least, the neglect of proper consideration of the matter of shoulders. In many cases the neglect referred to has unquestionably resulted in extravagance and waste in the long run, even if it has secured economy in first cost.

While authenticated records covering reasonable periods and concerning the relative expense for the proper maintenance of road crusts and of shoulders respectively are not readily available, certain instances of such records (as published concerning Park Heights Avenue, near Baltimore, Maryland),† together with the individual experiences related by many authorities, tend to show that the shoulder maintenance costs may be no inconsiderable part of the total maintenance costs of a modern road, and that it may often be real economy to build the road crusts wider in order to reduce this annual expense for maintaining the shoulders, and thus the total maintenance cost per square yard. From the Park Heights Avenue records, above referred to, it may be seen that, although the travel over the 24-ft. wide sections was four times that over the 12-ft. and 14-ft. sections, the cost of maintenance per square yard of the road crusts of the latter was more than twice that of the crusts on the wider sections, and the cost of maintenance on the shoulders on the narrower sections was nearly three times that for the shoulders along the wider crusts. Indeed, the economy in maintenance on both the shoulders and road crusts of the wider sections indicates that, in a ten-year period from the date of construction, real economy would have been had by increasing the width of the road crusts so that nowhere would the latter have been less than 18 ft.

But the subject for consideration is not "The Economical Widths of Road Crusts," but "Shoulders for Concrete Roads," and after the above specific illustration of the importance of shoulder consideration that of the actual subject may be resumed.

The actual width of the concrete roadway to be built must be determined by the traffic conditions to be expected on the road, and if these are sufficiently heavy to warrant so doing, it will probably be economical often to make the concrete itself wide enough to permit the passing of two lines of traffic wholly on its surface and without any necessity for either of passing vehicles to travel off the concrete on to the shoulder. On the other hand, traffic and other conditions may be such as to permit the greatest economy to be had by making the concrete only wide enough for one line of traffic and allowing the occasionally passing vehicle to travel on the shoulder for the moment.

The immediate vicinity of the line of contact between the edge of the concrete and the shoulder material will be found to be the tender region of both the road crust and of the shoulder. The high rigidity of the concrete road, and consequently the greater contrast between such a road crust and other material usually available for shoulders, increase the importance of the careful consideration in the matter.

Where the concrete road crust is so narrow that vehicles are almost constantly, in avoiding others, passing from the concrete to the shoulder, serious wear of both the road crust and the shoulder will be found to take place along the region of contact referred to, and this wear is frequently accompanied by the formation of a rut in the shoulder, which holds water in wet weather and thus endangers the foundation of the road. Some of the passing traffic will undoubtedly turn out on to the shoulder further than the rest, but at the extreme outside of the shoulder the travel over it may be so light and infrequent that the natural material there is not strained beyond what might be called "its elastic limit," and there, then, is no reason, on this account at least, for its replacement at any extra cost.

It will therefore be seen that the selection of the material and methods for the construction of shoulders to a concrete road requires the use of something between the natural soil, at the outside extremes, and the concrete itself; that the choices are determined by local conditions, such as availability of different materials and methods, width of the concrete road crust, amount of traffic, etc., and that the wearing abilities or "elastic limits" of the shoulder material at any point should be outside or above the stresses to be expected at that point.

The passage of traffic from the pavement to soft adjacent material can, of course, be absolutely prevented, and the protection of the edges of the pavement be had by the installation of a raised edging or kerb, as in the cases of most streets. The necessary reinforcement of the shoulder where no raised kerb is to prevent traffic going off it. In doing this the centre thickness of the crust need not necessarily be preserved to its edges, but the thickness may be tapered down somewhat at the outsides. Or this widening (and tapering down in thickness) of the road crust may be done over a portion of what might otherwise be the shoulder, and then the reinforcement continued by the use of macadam or pit gravel or other materials as may be necessary. Again, the width of the concrete road crust being fixed, the shoulder reinforcement may be had by the construction of pitch-concrete, pitch-macadam, water-bound macadam (with or without a pitch carpet), etc., adjoining the concrete road, all as may be necessary and desirable under the local conditions. The actual determination must be left to competent parties who will give due consideration to the local conditions and the principles referred to above.

This committee therefore endorses with its approval and recommends the adoption by this body of a clause similar to that in the recent report of the Special Committee (on Bituminous Materials for Road Construction, etc.) of the American Society of Civil Engineers, and as follows: "Where cement-concrete pavements are laid the edges should be protected, and a sudden transition from the pavement to any softer shoulder material avoided by means of cement-concrete or other edgings, or such reinforcement of the shoulder material as may be necessary."

The Hudson Bay Railway which will bring Saskatoon within 738 miles of tide water, and save 1,186 miles railway haul to Montreal, is progressing rapidly. By this fall, the line will be graded to a point 110 miles from Hudson Bay, while it is expected that by then rails will be laid to the first crossing of the Nelson River, at Manitou Falls, so that a train may be run to within 155 miles of the Bay.

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* Substance of report presented at the National Conference on Concrete Road Building (Chicago).

An Orillia Building Which Exemplifies Up-to-Date Factory Design

Staff Article

IN a new woodworking factory which is being built at Orillia for Messrs. J. R. Eaton & Sons Company, Limited, there are noteworthy features of design and construction. The general details of design are conveyed in the elevations reproduced on the opposite page, while the construction is shown clearly in the other illustrations. Generally, this plant may be said to embrace the most up-to-date principles in the design of buildings of this type and the factory upon completion in November will be one of the finest of its kind in Ontario.

The construction of the new Eaton factory was commenced last May. The site of the plant covers an area of nearly twelve acres. The main building is 151 ft. by 304 ft., one storey high, of mill construction. The boiler and engine room, dry kilns and store rooms are connected with the main section of the plant by a covered way. The roofing is of Barrett Specification felt and gravel. The walls are of Denison interlocking tile, manufactured by the Sun Brick Company, Limited, Toronto. It will be apparent to the reader that in the design of the building particular attention was paid to lighting, adequate light being provided from all sides. The flooring throughout is concrete and all possible precautions have been taken against fire. A sprinkler system has been installed. The timbers used in the construction are British Columbia fir, the posts being pine and hemlock, dressed 2 ins. by 4 ins. on edge.

New Plant of J. R. Eaton & Sons, Orillia, Ont.

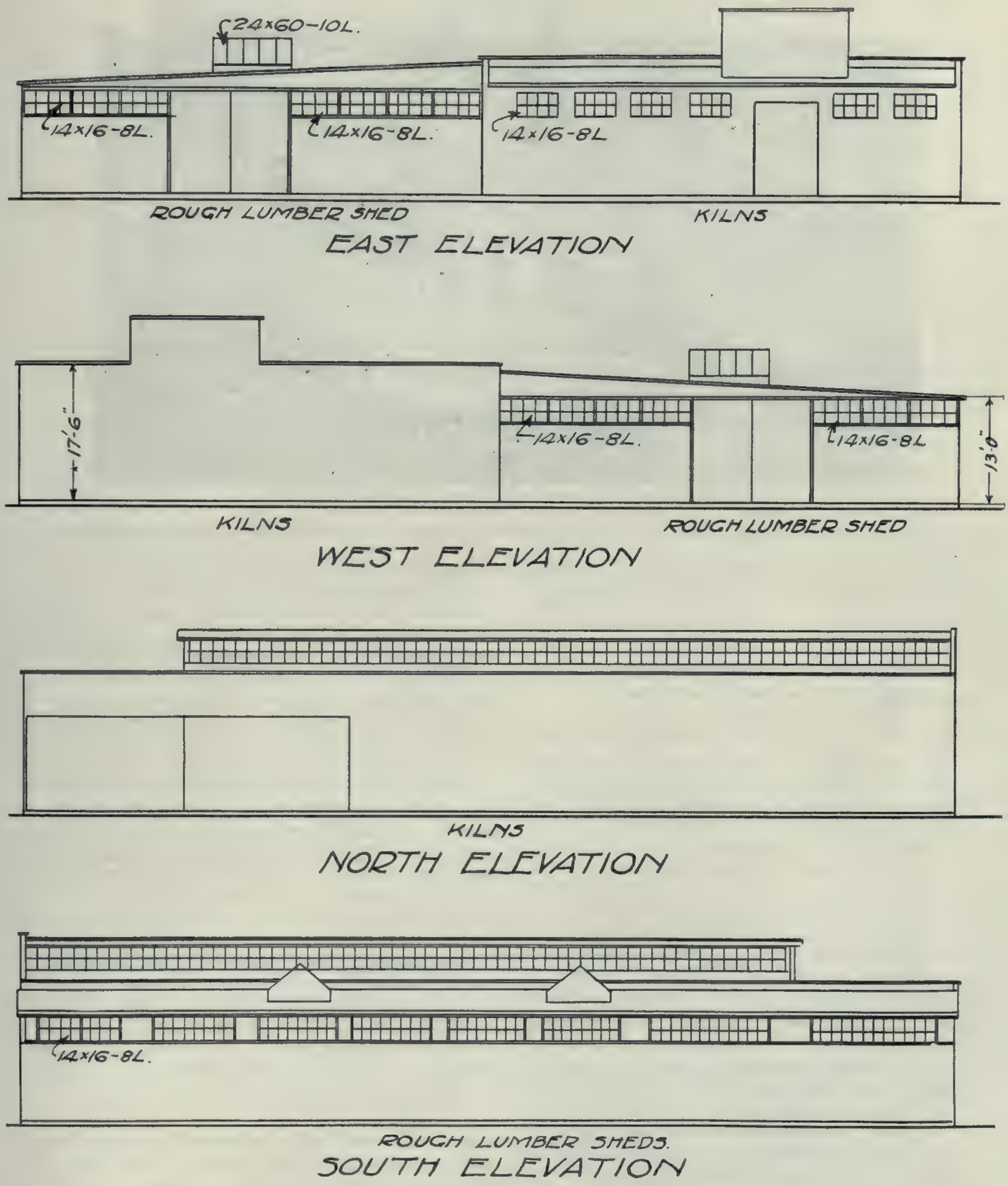
An interesting feature of the new plant is the box, or pocket,-type of dry kiln installed by the Grand Rapids Veneer Works, whose contract comprised eight fireproof box kilns of the latest pattern. These kilns are built of hollow tile and cement, with a unique system of transfers and elevators operated by electric power. The lumber is run in on the transfer car and discharged into the kilns. An important advantage claimed for the box over other types of dry kilns is the division of the former into eight boxes, four of which have a capacity of five cars each, the capacity of the other four being two cars each. By this means, variations of temperature are avoided, and different varieties of lumber, either hardwood or softwood, can be dried independently. The kiln is 120 ft. by 62 ft. Adjoining the kiln is a large storage shed for drying and storing the lumber as it emerges from the kiln. This building will be kept at a uniform temperature during the cold weather. A dressed lumber and storage shed is provided for loading and shipping the finished product. In the equipment of the plant an interesting feature is an endless chain conveyor, which takes the shavings and waste direct to the furnace. One of the most important factors in connection with this system is the claim that hand firing is rendered unnecessary by its use. Power is supplied by a Wheelock engine of 225 h.p., the electrical energy being generated on the premises.

The J. R. Eaton & Sons Company are manufacturers of general mill work, including hardwood flooring, exterior and interior finish. They wil lshortly have an up-to-date plant with excellent facilities which include a mile of sidings on the G. T. R.

The chimney stack will be built by that well-known firm, the Alphons Custodis Chimney Construction Company, of New York, whose Canadian office is in Toronto.

Geographically, Orillia is particularly favored in regard to the development of its various industries. The town is situated on the Trent Valley Canal, and

J. R. Eaton Company's main building in course of erection.



Elevations of the new factory of Messrs. J. R. Eaton & Sons Co., Limited, Orillia, Ont. The various illustrations are suggestive of a type of construction which is coming into increasing favor in industrial plants of this type. The facilities provided in the way of efficient lighting, and of having operations conducted on one floor, are important factors.

Dry kiln under construction at the J. R. Eaton Company's plant at Orillia, Ont.

is served by three transcontinental railways. During the last decade there has been a notable increase in population.

The Concrete Superintendent*

Qualifications That are Essential to His Success

By L. C. Wason

THE very first step which a contractor must take in starting the execution of a job is selecting a general superintendent to handle the work. The type that is hired for a single job, and discharged at its completion, is not worth having. The really desirable superintendent is a development from experience, the one survival from many tried; and, when once obtained, a firm cannot afford to lose him. Some owners and engineers appreciate the value of personality so much that they have given the writer's company contracts under condition that a certain superintendent be put in charge.

Frederick W. Taylor, in his excellent paper entitled "Shop Management," specifies nine different qualifications which go to make up a well-rounded man, namely: "Brains; education; special or technical knowledge; manual dexterity or strength; tact; energy; grit; honesty; judgment or common sense; and good health." He states that there are plenty of men to be found who embody three of these qualifications. Four make a higher-priced man. A man combining five is quite hard to get; and one combining six, seven, or eight is almost impossible.

If a building superintendent is to be successful, he must combine at least seven of these qualities. He must have brains, special and technical knowledge of both direct contract and sub-contract work, tact, energy, honesty, judgment, and good health. He must have a personality which drives to activity several hundred originally unorganized men who are without special interest in the company they work for or in the result accomplished, and with such tact and judgment as to weld them into a harmonious working force, cheerful and self-respecting, with high morale, and ultimately with enthusiasm for the work in hand. He carries a care so great that he builds in full size, with permanent materials, the intricacies of design which trouble the engineer's drafting room to show clearly on paper; with an honor so fine that the company is ready to leave its reputation in his hands, to trust him with funds; and with special experience so trained that dangerous operations are carried on as a matter of routine, without worry to himself or the company, yet with a constant oversight of a thousand chances for accident or perhaps death which may occur to the men in his charge; with a forethought so great that he sees ahead and provides for the problems which are to come up perhaps months later; with a temper so good that he never loses self-control under the most provoking circumstances, and is able to take with the best of grace changes in his plans from the office, and to work in the close co-operation with the company which is so necessary to make it an effective contracting organization.

Such men have a temperament that responds quickly to criticism or praise. Praise comes sparingly, even when deserved, while criticism is freely meted out. Superintendents in the employ of the company have recalled to memory words of appreciation from an owner or an engineer long after the job has faded from the writer's memory, and he has seen a man's work improve in quality and cost purely through praise for some detail of the work which was ably handled or some difficulty which was ingeniously overcome. The company, including its superintendent, feels as much pride in the jobs it does as do the engineers who have designed these structures. The members of the executive force on any job which is sharply criticized, will try to avoid criticism by refusing the slightest responsibility beyond what they believe to be clearly their own. A company sharply criticized by an engineer is likely to do precisely the same thing, and will throw onto the engineer every bit of responsibility which it can possibly avoid. The attitude of the engineer in this respect is reflected in the execution of the work. One engineer may call attention to a mistake with a letter that is harsh and ends with a sting, which leaves the feeling of injustice and soreness in the recipient. Another, in calling attention to a similar matter, ends his letter with some expression like the following: "We appreciate your wish to make this work as satisfactory as possible, and recognize that this occurred through failure to understand my exact requirements." In response to such a letter as the first, the tendency is to do just as little as will satisfy the engineer, and take your own time about it. But, as the writer knows from personal experience, in response to the second letter, you jump to correct the trouble cheerfully, quickly, and without comment, and also sometimes do more than was asked for.

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* From a paper—"The Problems of the Contractor," read before the Boston Society of Civil Engineers.

The problem in selecting the superintendent which the contractor must consider, is whether in the particular location he will be able to handle the difficulties which arise. Perhaps the owner and engineer desire an exceptionally fine appearance in the finished mill. One superintendent is especially good at this. Perhaps finish is of no great moment, and business ability is, on account of the job being isolated so that the superintendent is left alone for some days at a time. Perhaps the local conditions may demand a great deal of tact in the handling of labor. The following illustration shows what tact is required. When the writer's company executed its first contract in Buffalo, it was for a firm which had had considerable trouble with labor, and it was anticipated that there would be a strike before the job was very far advanced. This firm had been marked by the local labor organizations as their natural prey, and these organizations were also prejudiced against outside firms coming into their territory. The carpenters there have a strong organization. During the early stages of this job, while there were but a few carpenters, the superintendent could give them considerable personal attention, and things went smoothly; but as soon as work began on the second floor, where they could not be so easily seen and the superintendent was too busy with other matters to watch them closely, unit costs began to climb day by day. The superintendent studied the situation to find the cause. By the time form work was starting on the third storey, he became convinced that the union steward of the job was to blame and was holding the men back from doing their best. The natural impulse would have been to discharge him immediately, but that would have made hard feeling with the union. The superintendent took this man aside, confided to him his troubles, and then made this man sub-foreman with entire charge of erecting forms for columns, which was the particular item that showed the highest cost. Immediately the costs came down, and on the fourth storey were the lowest on the whole job. The result was saving a thoroughly first-class workman and keeping in the good graces of the local organization.

These various questions must be weighed and settled before a start is made. Experience has shown that after a job has once started with a given organization, a change in the superintendent is the cause of much disturbance to its satisfactory completion and economy in the handling of labor. It is of the most vital importance that this question be settled rightly once for all.

The Use of Filter Wells and Filter Cribs

THERE are in use several methods of filtration by the various consumers of Ohio River water, namely, the well system, the crib system, slow sand, rapid sand and the Smith system. These systems were described by Mr. C. E. Cooke, city engineer of Wheeling, W. Va., in a paper before the Central States Water Works Association. The well and crib systems are here described from information taken from that paper.

The well system either takes its water from wells drilled in the sand and gravel bars forming the bed of the river or from sand and gravel banks along the river, and in either case, the wells secure a large percentage of ground water. The wells are usually drilled wells with the casing driven down to or into the bed rock a short distance. The bottom of the casing is drilled with holes varying in diameter from ¼-in. to ½-in. Some of the well systems have a solid piece of casing at the bottom of the wells and then a perforated pipe above this solid piece. The water is either allowed to flow by gravity from the wells to the pumping station well and is then lifted by steam pumps to the consumer, or is lifted by compressed air out of these wells into a sub-basin and is then pumped to the consumer by steam pumps. The local conditions govern the method of furnishing the water used. The casing in the wells varies in diameter, as does the size and number of the perforations used. The well system generally supplies a water that is hygienically pure, but the water is nearly always harder than the river water, and, in some cases, wells have been known to show contamination after some years of use, as well as to show a considerable decrease in the quantity derived from the wells.

The crib system is usually built of timber, brick or concrete near the bank of the river with the water flowin and through the sand and gravel with which the crib has been filled. The river water filters through the said sand and gravel to the intake pipe of a pumping station and from there is pumped to the consumer. The danger of contamination is great in the crib system and the mud and silt are drawn through and into the sand and gravel, causing the crib to become clogged and the supply greatly, if not wholly, cut off. The crib is usually entirely submerged so that it is not readily accessible and so cannot be cleaned; thus the danger of contamination is great, and after contamination is found to exist, the only remedy is to abandon the crib or to cofferdam it and remove the sand and gravel, which is necessarily an expensive process and causes the consumer to use the raw river water during the execution of the work, thus contaminating the mains and services and opening the way for typhoid fever or other water-borne disease.—Engineering and Contracting.

On the North River, New York, a new pier is to be constructed, 1,050 ft. long and 150 ft. wide, and a corresponding half-pier, giving slips 360 ft. wide, and having a depth of water of 44 ft. Preliminary work has already made considerable headway, a cofferdom having been constructed on sheet steel piles, encircling an area of 800 ft. by 300 ft., so as to allow excavation of rock on the site to proceed in the dry.

Economic Factors Involved in Road Construction in Strictly Rural Sections*

It is fundamental that any outlay of money must be made in such a manner that it will result in a paying investment to the community. In order to obtain this not only the first cost of the improvement must be considered but the funds so invested must be protected from loss by waste and decay. The conclusions to be drawn from this are: (1) That no road should be improved without some provision for the maintenance of such road. (2) That all unprofitable work and works "de luxe" should be avoided within certain limits. (3) That all improvements not actually and positively needed should be omitted or postponed. As examples of such improvements the author may cite the adoption of costly surfacing for portions of roads where the traffic provided for will come at a later period, and all other unwise selections of surfacing either with a view to economize on the first cost or to display some luxury. (4) That the choice of some kind of pavement, the durability and ease of maintenance of which has not been ascertained in practice, be avoided as much as possible. (5) That unnecessary experiments be avoided. It is better to profit by experience obtained elsewhere and to make only those experiments which are absolutely necessary for adapting some good recognized product, process or method to local conditions.

Again, as the improvement of roads, like industrial or commercial investments, has to be a paying one, the sum invested should, in the author's opinion, be divided into three parts; one to be set aside for work which does not decay and can be easily and cheaply maintained without loss of value; one for work which decays and cannot be maintained without loss of value and for which a depreciation fund is to be provided; and a maintenance fund for annual repairs.

In the case of a macadamized road, for example, the cost of the earthwork, of the drainage and underdrainage and of the foundation should be considered as belonging to the first class; the cost of the surfacing to the second class, and to the third class the money required annually for maintenance.

Again, there should be no hesitation in spending money judiciously and when needed for earthworks, underdrainage, ditches, substantial, well designed and well constructed concrete bridges and culverts, and good and appropriate foundations.

All money so expended adds value to the country, prepares roads for the surfacing, even when the latter is to be laid later, and is remunerative. Such kind of work well planned and well made lasts a very long time and requires little money annually for maintenance. On the other hand it is a waste of money to use costly wearing coats on a substructure not well drained or a water-bound macadam on hills with a 10 per cent. slope.

Further, the author's impression is that the improvement of the roads should be begun by preparing the substructure, lowering grades or rounding up hills, drainage surface waters and under-drainage ground waters, constructing bridges, straightening unnecessarily tortuous roads, maintaining these improved substructures as earth or gravel roads as the case may be pending the next step of the improvement, and the laying of surfacing. All this can be done economically. Surfacing should be used only when and where necessary. This mode of procedure would have a great advantage which is worth being insisted upon. Laying wearing coats on new fills not sufficiently settled, or on a new soil not sufficiently trampled by traffic nor well seasoned, accounts for many failures of good surfacings and for expenses of maintenance greatly exceeding the provisions. Quick work in road making is not always to be recommended.

When the substructure of a road has been prepared and the foundation laid in advance, inconvenience is to be feared. Another occasional advantage is to divide the work. Contractors specializing in earthworks sometimes are not well acquainted with the laying of wearing coats, or have not at their disposal the skilled workmen required for such work, and the reverse is the case for surfacing contractors.

Width and Cross Section

The author does not advocate the spending at present of all available money in preparing substructures of rural roads. Provincial roads are badly needed and for these the work must be pushed quickly; but stress must be laid on the advisability in many cases of preparing the substructure of roads in advance, and on the inconvenience of laying surfacing on improper and unseasoned substructures. There is no standard cross section for substructures of roads, but details should be standardized in accordance with the results furnished by experience. The width of 24 ft. between ditches is not too great, but just what is needed for two wide automobiles or two hay wagons to pass each other, or a hay wagon to pass a wide automobile; for such cases plenty of room should be provided. It would be better to widen than to narrow the roads. When a horse vehicle meets an automobile, if the horses are nervous and deep ditches run alongside the road, a traveller often feels that 24 ft. is not too wide. This width should be reduced only in roads of secondary importance or when called for by special conditions. Even for roads much less important than provincial roads this width should be adopted if an increase of traffic is foreseen in the near future. In trunk roads the width between ditches may be increased if necessary to 32 ft. or more and should never be less than 24 ft.

On embankments the platform should receive an additional width of 3 ft. and have a total width of at least 27 ft. from edge to edge, because the back of the guard-rail posts should be set at least 1 ft. from the edge of the embankment.

In cuts, generally, no ditches are needed and gutters prevail; consequently, the total width of the platform at the bottom of the cut can usually be reduced to between 26 and 28 ft. for a 24-ft. wide road.

The edges of the embankments should be bevelled or rounded when the engineer has to deal with a clay soil, in which case it is useless to try to get sharp edges.

The slopes along the embankments and cut should generally be 1½ horizontal to 1 vertical, but engineers may avail themselves of the nature of the soil if well acquainted with the natural slope of one particular soil.

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*Abstracted by Engineering and Contracting from a paper by Gabriel Henry.

In this country it is necessary to avoid cuts on account of the snow, which, in winter, fills them and renders the road impracticable.

If the road is to receive its surfacing later, it should be given a transversal crown of at least 1 in. in the foot in order to shed the rain-water into the ditches and to allow maintenance with split-log drags. If the road is to immediately receive its surfacing, shoulders at least 4 ft. wide should be provided. The slope of these shoulders towards the ditches should be at least 1½ ins. to the foot.

Such are the principal features of a cross section of the substructure.

Earthwork

For the execution of the earthwork the same rules are to be followed as in the case of railways. For shrinkage the rates of fills to cuts comprise between 1.15 and 1.30—1.15 being for heavy work and 1.30 for light skimming work.

In the author's opinion the rolling grade system with vertical curves should be adopted, because it is more economical and facilitates the drainage of the substructure. It is useless to try to get at great cost long stretches of horizontal road. The maximum ruling grade should not be more than 5 per cent. whenever possible, 6 and 7 per cent. grades being resorted to only in short patches when absolutely imposed by necessity. A waterbound macadam is maintained only at great cost in this country on grades of 7 per cent. and more, and on account of the snow filling the ditches in the spring water from melting snow, in many places, injures the roads. The same holds for earth or gravel roads. It is better to try to get 5 per cent. by turning around hills when improving a road than by cutting them too much. Minimum grades should not be less than 0.6 per cent. to ensure the longitudinal drainage of the road.

Curves having a radius less than 300 ft. should be avoided in steep grades and at the foot of such grades, and a radius less than 200 ft. should always be avoided even in flat stretch. When it is necessary to adopt a radius less than 200 ft., the road should be widened in the curve and be given a transversal slope towards the centre of about 1 in. to the foot.

The end of the beginnin~ of a slope should not be found at a distance less than 50 ft. from a level crossing of a railway or from the end of a bridge. Sight distance in horizontal or vertical curves should be at least 300 ft., depending in each case on the conditions. Near a railroad crossing the sight distance on each side in the direction of the track should be at least 3,000 ft.

In every case, the economy of grading should not be the controlling factor. The most important considerations should always be kept in mind in determining the profile and the cross sections. The standards can be used as general guides, but good common sense and acquaintance with local conditions should have much to do with it.

The earthworks are computed as for railways, but for roads greater exactitude is needed because in this case they consist chiefly of skimming work, ditching and shouldering, which cost more per cubic yard and are more difficult to estimate exactly.

The draining of the soil is the most important thing in road construction, because the bearing power of the soil depends upon the moisture it contains. In this country this question is far more important than in the southern countries, owing to the nature of the climate.

The soil is soaked by rain-water and by ground-water. The rain-water should be disposed of as quickly as possible by a good, substantial system of ditches, gutters and culverts. Deep ditches should be avoided as much as possible and gutters substituted. Deep ditches are only necessary along flat stretches of road in order to get the necessary slope to cause a quick and complete drainage of water. The minimum slope to be given to ditches should be 5 ins. in 100 ft. Stagnant water should never be found in a ditch.

The greater slope depends upon the resisting power of the soil to abrasion by water and should never exceed such power.

The slopes of the sides of the ditches should be regular and as nearly as possible 1½ ft. horizontal to 1 ft. vertical. It is very difficult to attain this in a flat country where ditches have sometimes to be very deep and wide and would exceed the portion of the right-of-way that it is possible to set apart for them. In such cases rip-raps have to be resorted to. Gutters along hills should be paved with cobblestones whenever the soil is not hard enough to resist abrasion by running water.

Foundation

Tile underdrainage with good outlets is generally to be preferred to deep ditches for disposing of the ground water. Road underdrainage should be made in the same way as in the case of field drainage. Tiles should be laid under the sides of the road rather than under the centre, and should be disposed so as to intercept all water coming from the neighboring fields before they enter the right-of-way. It is important that good and frequent outlets should be provided. Underdrainage, in order to be a permanent and useful work, should be done with the greatest care. It is very difficult to drain a road effectively and completely, and in many cases it is impossible to get the ground water out. Generally, although the soil is dry, its bearing power is not great enough to stand concentrated wheel loads and it is impracticable to sufficiently consolidate it; sometimes a sufficient and effective underdrainage is impossible, and then it is necessary to resort to the use of a foundation in order to distribute the concentrated wheel loads over a wider surface.

The foundation plays the same role in the case of roads as ballast in the case of railways. It is generally assumed that the downward pressure follows a line at an angle of 45 deg. from the horizontal and is distributed over an area equal to the square of twice the depth of the total thickness of the surfacing and of the foundation. This is merely an assumption, but it is approximate enough in practice, and it has been found that the thickness of the foundation plus the thickness of the surfacing should not be less than 9 ins. in common soil for steel tire traffic.

A non-porous soil drained of ground-water will support a load of about 4 lbs. to the square inch; that is, about 1,300 lbs. per square inch applied to the surface of a coating 9 ins. thick per lineal inch of wagon tire. In practice a load of 700 to 800 lbs. per lineal inch of tire is assumed; that is, 2 to 2½ ins. per square inch on the substructure with a 9-in. thick surfacing including the thickness of the foundation.

Many good surfacings give bad results owing to the lack of a substantial foundation. For a soft tire traffic a foundation is not so necessary as for the traffic of wagons with narrow tires and without springs, the impact of which is very damaging to roads.

The foundation should be composed of stones not larger than 4 ins. and a filler in the voids is to be recommended whenever it is not very expensive. Gravel, as in the case of the railways, gives a good foundation and is even better than stone. Telford foundation should be resorted to only in case of necessity. Flat stones should not be used.

Waterways

Foundations are of the class of permanent works mentioned above. Bridges and culverts should also be so constructed as to be considered worthy of the same class.

Good concrete is well adapted for this kind of work. Concrete pipes should not be used in naturally wet clay soils, especially under heavy embankments. They should be of ordinary thickenss and of a diameter not larger than 30 ins. under embankments higher than 14 ft. In these two cases box culverts would be preferable. Sand cushions should be employed to protect them against rock. It is absolutely necessary to give the head walls a firm seat, especially in clay soils and when the pipes are under an embankment. Concrete slab bridges are very useful as well as concrete girder bridges. The maximum economical span of a slab bridge is about 15 ft. and of a girder bridge between 15 and 30 ft. or more. Under high embankments arch culverts should be used.

Concrete trestle bridges are especially recommended for use on rivers where numerous deep gullies are found, as this type of bridge spans them very economically and artistically, thus dispensing with heavy embankments and deep cuts. The latter ought always to be avoided in this country on account of snow.

Many difficulties are encountered in fixing the dimensions of the culverts because the road engineer has, when deciding, to deal with the farmers. The same difficulties are met with when straightening tortuous, crooked roads and improving curves. These difficulties are not technical, but are of common occurence in all countries, being unpleasant and unavoidable. The greatest care should be taken in the planning and construction of bridges and culverts for which the same general rules have to be followed as in the case of railways and of first class concrete work.

Road Surfaces

The cost of the permanent work, that is, of the part of the outlay permanently invested in the case of roads, is a smaller fraction of the total cost than is generally supposed. Except in special cases, it never exceeds one-quarter or one-third of the cost of the surfacing proper, and in the case of special wearing coats this proportion is still smaller; consequently, great care should be taken in the choice and the laying of this part of the road which is short lived and so expensive.

The following points should be taken into consideration when making a choice:

(1) Not to attempt to risk surfacings on a substructure which is not sufficiently firm with or without foundation. Waterbound macadam is not excepted. (2) Not to use surfacing in places where floods or other causes could damage same. (3) Not to use costly surfacing when a less costly could reasonably do as well for the number of years the less costly is supposed to last. (4) Not to use costly surfacing when the amount of the total sum of the first cost of the sinking fund and of the maintenance of the said surfacing is higher than with a less costly wearing coat which would do as well.

There is a great variety of surfacings. Leaving aside the earth, sand, slay, clay and ordinary gravel roads which are, as previously stated, very convenient in the majority of the rural roads where traffic is only local and light, the principal surfacings for highways and rural roads are: Waterbound macadam and waterbound gravel macadam; asphaltic macadam, penetration method; asphaltic concrete, mixing method; tar macadam, penetration method; tar concrete; cement concrete surfacing, penetration method (Hassam process); cement concrete surfacing, mixing method; and vitrified brick.

This is a rough classification. Many attempts have been made elsewhere to properly classify and name the road surfacings, but a complete understanding has not yet been arrived at. Of course, the composition of aggregate used with bituminous or tar cement, for instance, in the mixing and penetration methods, varies greatly and sometimes there is little difference between the aggregate used in the two methods. The names of the surfacing are very numerous, depending on some process in the execution of the work and on the nature of the cement and aggregate used.

Apart from the above surfacing some chemical product, such as rocmac, are found on the market, the function of these being to bind or help to bind stone in the macadam.

Tar, bitumen oils and other chemical or residual products such as calcium chloride and glutin should also be mentioned. Their functions are to protect the road surfacings against the wheels of vehicles, to give them a longer life and to lay dust. These preventives have to be renewed more or less frequently.

The author is merely speaking here of the surfacing and preventives generally used in rural road and highway work and not of the still more expensive paving used in cities.

Now what is to be said in regard to all the above named surfacings? There are such great and important interests concerned in bitumen, tar and cement surfacings, success and failure are in fact so mixed up and the experiments, as reported, have given such widely varying results, that it would be very difficult to give a categorical opinion.

Economic Considerations Involved in the Selection of Surfaces

With the economical aspect of the question in view the following conclusions can be drawn:

There is not at present any surfacing good for general purposes. Automobile traffic requires certain qualities for surfacing, and the narrow steel tires, heavily loaded wagons and motor trucks need others.

All kinds of surfacing can be used with advantage if judiciously and suitably chosen, well laid and maintained.

All surfacings require to be maintained with the greatest care.

A combination of steel tire and of soft tire traffic in different proportions requires in each case specially appropriate surfacing.

Bituminous macadam and bituminous concrete macadam, as well as tar, are very suitable for automobile traffic.

Experiments on concrete roads point towards a more general use of concrete surfacing, which does not seem to be affected by a cold climate.

Waterbound macadam, well built, is good for rural roads where automobile traffic is not heavy. Tarring and oiling lengthen its life and allow a medium heavy automobile traffic on it.

All that has been said above presumes that the substructure of the road has been sufficiently drained, that a substantial foundation has been provided for, and that the sum of the thickness of the foundation and of the surfacing are in keeping with the nature and the dryness of the substructure. The road is also supposed to be maintained with care.

In choosing a surfacing the following should be taken into account: (1) The nature and importance of the traffic both present and future; (2) the first cost of the surfacing; (3) the probable life of the surfacing; (4) the cost of its maintenance.

Such information is now easily obtained, and by adding in each case the interest on the first cost, the annual annuity for depreciation fund and the probable annual cost of maintenance of two or more surfacings, the total will indicate the one to be chosen. The first cost should be established as first class.

It may be added here that bituminous and tar surfacing require very great care and experience to be laid properly and that it is more difficult to lay them in this country than in a dry climate.

The annual period of work in the Province of Quebec is about 100 working days; rainy days are frequent as well as variations of temperature, which are at the same time very great.

For a good bituminous and tar surfacing the stone must be dry and not very cold when cement is added. The degree at which the bitumen or tar is to be heated depends to a certain extent on the temperature of the stone and of the atmosphere, and in the autumn the weather is often wet and cold.

Waterbound Macadam

With waterbound macadam, as well as other pavings and especially concrete paving, the quality of the stone plays an important role. Soft stone should be avoided as much as possible.

In the Province of Quebec trap and good rock for road purposes are scarce. Field stones are generally employed and the quality varies greatly as they are generally mixed with bad stones. Sandstone of inferior quality is very common; in some districts a kind of bad granite is found, while gravel and quarries with good material for road purposes are scarce.

For waterbound macadam, the author advocates the two-course macadam—bottom course, 4 ins. loose stones of 2½ ins. ring, well rolled with a steam roller of at least 10 tons, no filler; top course, 4 ins. loose stones of 2½ ins. ring, an appropriate binder entered dry in the course with broom and roller in as great a quantity as possible. The first layer of the binder should be applied before the rolling is begun, and when it is not possible to enter more binder without the roller spraying is resorted to.

The road should be sprinkled until saturated, the sprinkler being followed by the roller. More screenings must be added if needed, and the sweeping, sprinkling and rolling continued until a grout has been formed of the screenings, stone dust and water to fill all voids and form a wave before the wheels of the roller. After that, enough screenings should be spread over the macadam to leave a wearing surface at least three-eighths of an inch thick.

With limestone a coarse-grained sand, as well as the dust of the crusher, is good, but with granite a limestone binder is generally required. In some districts of the Province only sandstone is available. A limestone binder would be suitable with these stones, but, unfortunately, in these districts no limestone is found, and in such cases the dust from the crusher or the sand is of no value and it is impossible to bind the macadam. Thus the only way to obtain a first bond is to use clay and the traffic does the rest, but for two or three years it is necessary to keep the ruts filled and the surface even. Experience shows that it is possible to obtain good results in this way.

The crown of the macadam is generally ¾ in. for a 16-ft. wide surfacing; for a bituminous or tar surfacing ½ in. is enough; for concrete ⅛ in. is suitable.

The choice of a macadam as a surfacing depends not only upon the nature and the importance of the traffic, but also on the quality and the price of the stone. When the stone is of bad quality and dear, it is often more economical to use a more expensive surfacing. In the opinion of the author, the best macadam would be of one-sized stone 2½ ins. ring, with an ordinary soil, a total thickness of about 9 ins. comprising the foundation; also macadam stone should not be mixed with an undue quantity of smaller stones or sand. For a wearing course such a mixture containing too great a proportion of small-sized stones and of screenings is not suitable. As a rule it is not uniform, the larger and smaller sizes have a tendency to separate and, if not mixed with care and laid with shovels, the resulting macadam will have a very irregular wearing quality, and ruts and depressions will consequently follow.

It is very difficult to obtain the one-sized stone at a suitable price in the Province of Quebec because few regular quarries sell macadam stone. It is necessary to use transportable crushers, but these give many flat chips which must be utilized. Meanwhile, everything should be done in order to obtain the standard cubical uniformly sized stone.

The preventives mentioned above are serviceable in many cases, but their cost compared with results is rather high and generally have to be applied at least every year. Tarring, however, has given very good results.

The question of the width of the surfacings is not yet completely settled. Meanwhile experience shows that a width of 16 ft. is suitable for a provincial road and for less important roads 14 ft. is convenient. Shoulders should have a width of at least 4 ft.

Financing Road Improvements

The advent of automobiles, although an important factor in the question of roads, does not particularly affect the rural roads because automobiles will not for some years increase in such number in rural districts as to cause apprehension to the farmers on account of additional expense in maintenance. It only affects such roads in the sense that automobilists ask for better rural roads; while the difficulty lies in the fact that they desire many highways crossing the country which the farmers contend are not necessary to them and which they will not maintain. Who then is to pay?

The improvement of rural roads will benefit the whole country, as well as the farmers, the municipalities and the automobilists.

The provincial highways will also benefit the country, the farmers and the automobilists.

It thus seems justifiable to divide the cost of improvement and maintenance of the roads of the Province between the three interested parties.

What is to be the proportion for each of them? This is a very intricate question, but one which can be solved.

For speedy work, money is not at hand here as elsewhere. The system of long term bonds in the United States came first on the assumption that the next generation would benefit by the improvement as well as the present one. But complaints soon arose. One thing had been overlooked, and that was the difference between permanent work and passing or short lived work.

For permanent work long term bonds can be used. Short lived work constitutes the larger proportion of surfacing. A good bituminous surfacing is said to last from 10 to 15 years with a moderately high traffic in spite of the maintenance. Consequently, for such surfacing only 10-year bonds would be advisable.

For this kind of surfacing, which on account of its high first cost is chiefly used on highways with an important traffic, long-term bonds should be avoided because, in spite of maintenance, long stretches have to be renewed at the same time. A macadam well maintained and without automobile traffic will last a long time, as has been proved by many examples in the old countries, provided the maintenance is complete and effective, the material for macadam being generally at hand and good road men being found easily along the road and put in charge of the work. In such cases longer bonds are to a certain extent reasonable.

Large Works Completed by the C.P.R.

IN spite of the depression from which all interests suffered more or less, even before the war broke out, it may be interesting to recapitulate the outstanding features of the work carried out by the C. P. R. during the present year from January to date on its whole system.

At McAdam Junction the C. P. R. recently completed a new machine and erecting shop and added over one mile of new storage tracks.

A fireproof elevator with a capacity for 1,000,000 bushels with an up-to-date power plant was completed this summer at West St. John, not to speak of great improvements to the terminal facilities. The improvements at the passenger and freight terminals at the Windsor station are marked by bulk and efficiency. The train shed, which is just completed, is one of the largest of the most modern types now in use. At the same time the improvements at Place Viger, which have been in hand for three years, are now completed. These, in their entirety, of station, hotel and trackage, cost nearly $5,000,000.

The Union station at Quebec has been commenced. There were the double track bridge at Lachine which cost nearly $3,000,000; the new Lake Shore Line which was opened for traffic in June; the new station and viaduct at Toronto which are only held up temporarily; the extension of the Kippewa Branch line 10 miles in a northerly direction; a 30-mile extension from Expanse to a junction with the Weyburn-Sterling branch of the C. P. R., and which will be completed this fall; the line between Swift Current and Empress, a distance of 112 miles, and which will be completed this year; the main line cut off from Swift Current to Bassano of which 150 miles are completed; the 78 miles of the C. P. R. branch from Lacombe to Kerrobert, a new extension; the operation of the Alberta-Central Railway to Lochern, a distance of 65 miles from Red Deer; the great tunnel at Roger's Pass, and of which one mile of the pioneer tunnel has been completed; the C. P. R. depot and terminal offices at Vancouver; the Kootenay Central which is now open for traffic, from Golden, 60 miles south. Work on this road is being pushed vigorously on the line to join up Golden and Colvalli; the opening of the Esquimalt and Nanaimo line from Parksville junction to Courtenay.

The C. P. R. is interested in the Kettle Valley Railway, and in connection with the same it is building a line from Midway to Penticton—a distance of 134 miles, 76 of which are already open for traffic. A line from Penticton to Osprey, 41 miles in length, has been completed, and work has been commenced on a new line between Osprey Lake and Princeton. The Kettle Valley Railway is also building a line 54 miles in length between Hope and Otter Summit. A part of the track has already been laid.

In addition to all this, which is merely hinted at, and which is a record of eight months, the C. P. R. has continued its policy of double tracking all the way through.

In the annual report of the Deputy Minister of Public Works for Alberta it is shown that 316 wooden bridges and 16 steel spans were built by the Department during 1913. Repairs to bridges numbered 98. A large amount of trunk road work was completed. Record is made of the completion of the Parliament Buildings at Edmonton, the erection of the Government House at Edmonton, the land titles building at Edmonton, and agricultural schools at Olds, Claresholm and Vermillion. The work in the surveys branch showed an increase over previous years.

Paving Brick Manufacturers at Buffalo

The 11th annual meeting of the National Brick Manufacturers' Association held at Buffalo recently was attended by upwards of two hundred and fifty manufacturers and others interested in municipal and highway work. The attendance included many city and county engineers, besides a good representation of the engineering and technical schools. A number of trips of inspection were made over the Erie county highway, which furnished an excellent opportunity for the study of brick pavement construction. The various stages of the work were discussed in detail en route. A conference held between the Brick Committee of the American Society of Municipal Improvements and the manufacturers developed many interesting suggestions and resulted in a recommendation for factory inspection of brick for abrasion loss. The election of officers resulted in the return of the President, Mr. Chas. J. Deckman, Cleveland, and also of the Secretary, Mr. W. P. Blair, and Assistant Secretary, Mr. H. H. Macdonald, both of Cleveland.

Personal Mention

Professor W. C. Rowse, a graduate of Perdue University, has been appointed Professor of Mechanical Engineering in the University of Manitoba.

The marriage of Mr. C. P. Waterous, Superintendent of the Waterous Engine Works Company, St. Paul, Minn., and Miss Fanny Nagle, daughter of Mrs. F. A. Nagle, 61 Chesterfield Avenue, Westmount, was celebrated in that city on September 16. Mr. Waterous is the grandson of the founder of the well-known Waterous Engine Works Company, Limited, Brantford, Ont., of which the St. Paul plant is a branch.

Mainly Constructional

East and West—From Coast to Coast

It is affirmed that there will be no cessation of construction on the new $5,000,000 plant of the Dominion Shipbuilding and Drydock Company, Limited, at North Vancouver, B.C.

The Ford Motor Company's factory on Christie Street, Toronto, is well advanced towards completion. The total cost of the building is $250,000. The general contractors are the T. W. Mack Construction Company, of Toronto.

The new stadium for McGill University, Montreal, is in course of erection. The architects are Messrs. Nobbs & Hyde, and the general contractors Messrs. L. A. Ott & Company, both of Montreal. The estimated cost is $100,000.

The erection of the Sacred Heart Cathedral at Prince Albert, Sask., is proceeding satisfactorily. The new edifice will be 162 ft. by 75 ft. in dimension, of brick and stone construction. The estimated cost is $150,000. The architect is Mr. A. G. Creighton, of Prince Albert.

Mr. K. Nakamura, an eminent Japanese civil engineer, was a recent visitor at the Grand Trunk headquarters in Montreal. Mr. Nakamura, who is with the South Manchurian Railway Company, has been touring the world with a view to acquiring railway engineering pointers.

The Burrard Inlet Tunnel & Bridge Company, Limited, has had no meeting since the war broke out. Plans for its $2,000,000 bridge have been taken under advisement and are now being adjudicated upon by Ralph Modjeski, at Chicago, Ill. Contracts will probably be let later.

At Niagara Falls, roofing is now in progress on the chain factory which is being erected by the Dominion Chain Company, at a cost of $150,000. The building is two storeys high, of reinforced concrete and steel construction. Mr. E. D. Pitt, of Niagara Falls, is the architect.

At Victoria, B.C., operations are in progress on the First Presbyterian Church, which is being erected at a cost of $125,000. The architect is Mr. J. C. M. Keith, and the general contractors are Messrs. Stevens Bros., Victoria. It is hoped to have the building completed by May next.

Announcement is made that the Proctor-Gamble Company will start work on the construction of their new $1,000,000 plant at Hamilton within the next month. All orders for the supply of building material will be placed locally. The firm expect to employ three or four hundred men at the outset.

Mr. J. H. McDowell, of Montreal, is the architect and Mr. F. Hoadley is the engineer for the new theatre which is to be erected on St. Catharine Street, Montreal, at a cost of $200,000. The building will be of brick and terra cotta construction. Mr. Maurice Wolfe, of Montreal, is interested in the project.

At Winnipeg, steel work is advancing rapidly on the Coca Cola Company's new warehouse which is being erected on Bannatyne Avenue at a cost of $550,000. The general contractors are Messrs. Jas. McDiarmid Company, Winnipeg. The Manitoba Bridge & Iron Works, Winnipeg, are doing the iron work.

The British Columbia Steel Company, Limited, has completed plans for the establishment of a $200,000 steel plant at Bridgeport, B.C., and the stock is now on the market. The company states that it will shortly commence building operations. The head office of the company is at Vancouver, B.C., and many prominent business men of the city, including Francis Leighton, general manager of the Vancouver Engineering Works, Limited, are named as provisional directors.

Operations are proceeding on the erection of a factory which is being erected at Medicine Hat for the Saskatchewan Iron & Bridge Works. The steel work has now been completed. The structure will be 40 ft. high, 200 ft. by 100 ft. in dimensions, of steel and brick construction. The estimated cost is $100,000.

Announcement is made that operations are to be started on the erection of a steel manufacturing plant at Ojibway, Ont. (near Windsor) for the United States Steel Corporation, of New York City. The estimated total expenditure involved is $20,000,000. A branch of the Essex Terminal Railway is to be laid to the site of the plant.

Messrs. Geo. H. Gooderham and G. F. Beer, of Toronto; G. G. Marlott, of Oakville; M. C. Smith, of Burlington, and T. W. Jutten, of Hamilton, have been appointed a special commission to make arrangements for the building of the concrete roadway from Toronto to Hamilton. Mr. Gooderham is chairman. The estimated expenditure is $600,000.

The various municipalities concerned are interesting themselves in the proposal to have the Ottawa-Prescott road construction started without delay. Controller Champagne, of Ottawa, was in Toronto recently interviewing Hon. Dr. Reaume and other provincial authorities in this connection. The idea is to get the work under way in order to provide employment during the winter.

At New Westminster, work is progressing on the harbor improvement scheme, and it is expected that the new wharf of the city on Front Street will be finished in about three weeks. The total cost of this work, including the cost of the construction plant, is estimated at $19,283. Work done last month cost $30,000, leaving the sum of $180,716 to be still expended out of the half million dollar by-law.

The award of contracts for the proposed soap works to be established by the Royal Crown Soap Works, Limited, of Vancouver, B.C. (closely identified with Lever Bros., Port Sunlight, England), on the south shore of Burrard Inlet, near the Second Narrows, has been deferred on account of the war situation. Bids were closed nearly two weeks ago. The enterprise was to have been financed in London and the plans called for the expenditure of $250,000.

Mr. F. H. Herbert, a well-known architect who had been practising in Toronto for a quarter of a century, died last week. The deceased gentleman was born at Bath, Eng., forty-nine years ago and came to Toronto at an early age, studying his profession under the late Mr. Ough. Mr. Herbert was the architect for the Mutual Street Arena, Toronto, but he is best known as the designer of many important industrial buildings throughout the province.

Construction is well advanced on the large dyke over the Falcon River which is being built in connection with the Greater Winnipeg Water Scheme. The contractors are Messrs. Tomlinson & Fleming, and the cost of the work is placed at nearly $121,000. The dyke is for the diversion of the Falcon River and requires an embankment 5,000 ft. long and a channel 3,000 ft. long, 35 ft. wide and 7 ft. deep. The contract calls for the removal of 30,000 cu. ft. of earth.

Work on the new bank and office building which is being erected at Winnipeg by the Quebec Bank, is nearing completion. The structure is 108 feet by 62 feet in dimensions, and contains four storeys and basement. The construction is steel, brick and reinforced concrete. The architects are Messrs. Brown & Vallance, and the general contractors Messrs. Carter-Halls-Aldinger Company, both Winnipeg firms.

Contracts Department

News of Special Interest to Contractors, Engineers, Manufacturers and Dealers in Building Supplies

Waterworks, Sewerage and Roadways

Bedford, Que.
By-law has been carried and tenders will be called next spring in connection with extensions to Waterworks, estimated to cost $35,000.

Previous tenders for construction of macadam roads were unsatisfactory, and new tenders will be called in about two weeks. Work is estimated to cost $23,000.

Bridgeburg, Ont.
Queen Victoria Park Commissioners will receive tenders until October 5th for construction of concrete roadway with necessary drainage through villages of Bridgeburg and Fort Erie. Distance approximately 8,500 feet. Plans and specification at Administration Building, Queen Victoria Park, Niagara Falls, Ont. Mr. John H. Jackson, Niagara Falls, is Superintendent.

Bridgetown, N.S.
Ratepayers are voting on by-law seeking authority to construct sewer and water extensions at estimated cost of $3,200. Mr. Harry Ruggles is Clerk.

Chatham, Ont.
City Council has had plans drawn for laying 9,150 sq. yds. concrete pavement. Estimated cost $12,500. Work will be day labor under supervision of Mr. F. P. Adams, Engineer, City Hall. Mr. W. G. Merr is City Clerk.

Hamilton, Ont.
Tenders will be received by Mr. A. F. Macallum, City Engineer, for the following work in connection with laying of Cement Sewer Pipe at an estimated cost of $140,000:—240 ft. 60-inch pipe; 2,410 ft. of 54-inch pipe; 256 ft. of 48-inch pipe; 480 ft. of 33-inch pipe; 1,680 ft. of 30-inch pipe; 1,100 ft. of 30-inch half-section Cement Pipe.

Hawkesbury, Ont.
Town Council contemplates construction of Sewers and Water Mains this fall.

L'Original, Ont.
Work is to start on construction of 4,000 lineal feet of Concrete Sidewalks for Village Council. Estimated cost $2,500. Kelmer & Winshanley, Morrisburg, are General Contractors.

Leamington, Ont.
Tenders will probably be called shortly for construction of Sewer for Town Council, estimated to cost $35,000. Mr. John A. Baird is Engineer; Mr. R. M. Selkirk, Clerk.

Work on construction of 1⅝ miles of Rocmac Pavement has been started by Rocmac Roads Limited, 74 King Street East, Toronto.

Peterborough, Ont.
City Council will invite tenders shortly for construction of concrete sewer outfall. Mr. S. R. Williams is Clerk and Mr. R. H. Parsons Engineer.

Port Hope, Ont.
Town Council has agreed to carry out improvement to Waterworks system in form of extensions to Intake Pipe as suggested by Provincial Board of Health. Mr. J. W. Saunders is the Clerk.

Regina, Sask.
City Council is contemplating extension to pump house at sewage disposal works, estimated to cost $5,000. Mr. F. McArthur is Engineer.

Souris, P.E.I.
Tenders are to be called next spring in connection with installation of sewage and water system in public buildings, for Dominion Government Department of Public Works. All information may be obtained from Inspector of Buildings, Mr. J. J. McDuff, 46 Bayfield street, Charlottetown, P.E.I.

Sussex, N.B.
A large number of sewers are to be erected next year by the Town Council. Mr. Grey Murdock, Carnarthen Street, St. John, is Engineer; Mr. W. D. Turner, Clerk.

Tignish, P.E.I.
Construction of sewer drain from Public Building to Seashore (approximately one mile) for Dominion Government Department of Public Works, is likely to start next spring.

Toronto, Ont.
Tenders close October 13th for Construction of Sewers on fifteen Streets. Plans, etc., are at Office of Works Dept., City Hall.

The following gentlemen have been appointed by Ontario Cabinet a Special Commission to carry out construction of $600,000 roadway from Toronto to Hamilton:—George H. Gooderham, M.P.P. (chairman), Toronto; G. F. Beer, Ryrie Building, Toronto; C. G. Marlott, Oakville; M. C. Smith, Burlington; and T. W. Jutten, Hamilton.

Mr. R. C. Harris, Commissioner of Works, has recommended pavement on a number of streets, estimated at the following cost: Asphalt, $216,412; brick block, $55,853; bitulithic, $32,615; wood block, $4,056, concrete curbings, $5,042.

Works Commissioner Harris will recommend the laying of Cement sidewalks on several streets at estimated cost of $53,000.

West Zorra, Ont.
The following contracts have been awarded for construction of drain for Township Council: General Contractor, R. H. Alexander, R.R. No. 2 Embro, $2,086.70. Contract for supply of tile has been awarded to F. O. Campbell, St. Mary's, at $1,600.

CONTRACTS AWARDED

Regina, Sask.
City Council has awarded contract to Thomas Gibson & Company, 1006 Union Trust Building, Winnipeg, for 50,000 feet of lumber at $19 per M., in connection with construction of plank sidewalks on various streets. Work will be done by day labor.

The contract for construction of additional filter beds in extension to sewage disposal works has been awarded by City Council to O. W. Smith, 4 Peart Block, at $19,142 and to McKenzie, Hazel Company, Regina, for 1,200 cords of field stone at $9 per cord f.o.b. Regina. Extension scheme is estimated to cost $50,000.

Toronto, Ont.
Board of Control has awarded the contract for supply of 232,000 Dunn Wire-Cut Lug Blocks for paving, at $31.50 per M., to F. B. Goodman, 464 Markham St.

Winnipeg, Man.
Greater Winnipeg Water District has awarded the following contracts in connection with Construction of Aqueduct at estimated cost of $6,142,640; Messrs. J. H. Tremblay, Limited, 814 Sterling Bank Bldg., $945,945; Messrs. T. Kelly & Sons, 504 Lindsay Bldg., $1,301,485; Northern Construction Company, 606 Union Bank Bldg., and Carter, Hall & Aldinger, 1010 Union Bank Bldg., $3,895,210.

Railroads, Bridges and Wharves

Chatham, Ont.
Plans are in progress for construction of 16 concrete and Steel Bridges, 35 ft. by 16 ft. span; also dredging work. Estimated outlay $84,000, for City Council and Dover Twp. Mr. W. G. Merritt is clerk and Mr. Geo. A. McCubbin, 135 King Street West, Engineer.

Dundas, Ont.
The Town Council is having plans prepader for construction of steel bridge to be erected over Court Street.

Dover Township, Ont.
Work is to commence on construction of Steel and Concrete Bridge over Mill's Drain and Chatham Townline for Township Council. Work will be done by day labor. Mr. Jno. Welsh, 94 Grand Avenue W., Chatham, is Clerk, and Mr. W. G. McGeorge, 153 Queen Street, Chatham, Engineer. Work will be done by day labor.

General contract for erecting steel and concrete bridge over Gowrie drain of Big Point Road has been awarded by Township Council to Chatham Bridge Company, 206 Inhes Avenue, Chatham.

Hull, P.Q.
Ontario Electric Railway Company is contemplating extension of its Street Railway System in this town. Mr. F.

ESTABLISHED 1886

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Alphabetical Index of Advertisers
Page 18

Vol. 28 October 7, 1914 No. 40

Principal Contents

The MacLean Building 1231
The Example of the Dominion Government 1231
The Canadian Pacific Railway's New Six-Storey Warehouse at Toronto 1232-3
Replacing a 250-ft. Reinforced Concrete Chimney... 1233-4
A Method of Proportioning Concrete 1234-5
By Wm. B. Hunter
Waves in Road Crusts 1236-7
Economy and Efficiency in Pavement Construction. 1238-9
By H. B. Pullar
The Meaning of "Macadam" 1240-1
The Value of a Library in an Engineering Office .. 1241-3
By L. B. Krause
Control of Reinforced Concrete Construction 1243-4
By W. K. Hatt
Painting Concrete Surfaces 1244
The Proposed Civic Centre at Vancouver 1244
General Points on Moving Large Structures 1245
The wiring of Large Public Buildings 1246
Reporting on Public Service Properties 1247-8
By E. P. Roberts
Canada's Trade with Germany 1249
The Cost of Doing Business as a Factor in Contract Work 1250-1
By Edwin L. Seabrook
Constructional Features of a Double-Deck Car Barn at Vancouver 1252-3
Dr. W. A. Parks—Biographical Sketch 1254
Constructional News and Industrial Notes 1255-6

The MacLean Building

THE accompanying illustration shows the new offices of the Contract Record and Engineering Review in the MacLean Building, 347 Adelaide Street West (corner Charlotte Street), Toronto. Readers are requested to note the change of address. The Telephone numbers have also been changed and a switchboard has been installed to provide a more adequate service. Hereafter all Departments will be reached by calling Adelaide 2700.

The Example of the Dominion Government

WHATEVER bodies may be brought under the levelling influence of adverse criticism during the Empire's present extremity, the Dominion Government must be exempted. The example set by Ottawa stands out in bold relief as one of signal confidence and collectedness. We have the reassuring word that preparations for meeting the exigencies of the coming winter are taking the form of arrangements for continuing work on all the large public undertakings now under way. At the present time these works are giving employment to many thousands, and the importance of the decision cannot be over-estimated. At Halifax there are the extensive terminals of the Intercolonial Railway; at St. John there is the large harbor development at Courtenay Bay; while Quebec, Montreal and Toronto have great improvement schemes in progress which involve the expenditure of many millions of dollars. Then there are the Welland Canal works, the Port Arthur and Fort William construction, and the docks and harbor works at Vancouver and Victoria. The continuation of construction on these enterprises will keep large staffs of men employed and have an appreciable effect upon the circulation of money in the constructional field.

There can be no disguising the fact that many have viewed the situation arising out of the present conflict with something like panic. This has resulted in the needless closure of a great deal of work—a closure which has brought unnecessary loss to owner, contractor and workman, to say nothing of the depressing influence that it has exerted in other directions. Ottawa's example is in direct contrast to this, and the official view represents almost the extreme of optimism. The bank statement issued at Ottawa last week, which covered the first month of the war, is regarded most favorably and the statement for the current month will show the greater extent to which circulation has increased for the maintenance of the country's industry and commerce.

The test of good government is its ability to withstand severe stress. Ottawa has been tried and not found lacking. Its solid front in regard to the maintenance of constructional activity should make an impression upon those of admittedly lesser foresight.

Canadian Pacific Railway Company's New Six-Storey Warehouse at Toronto

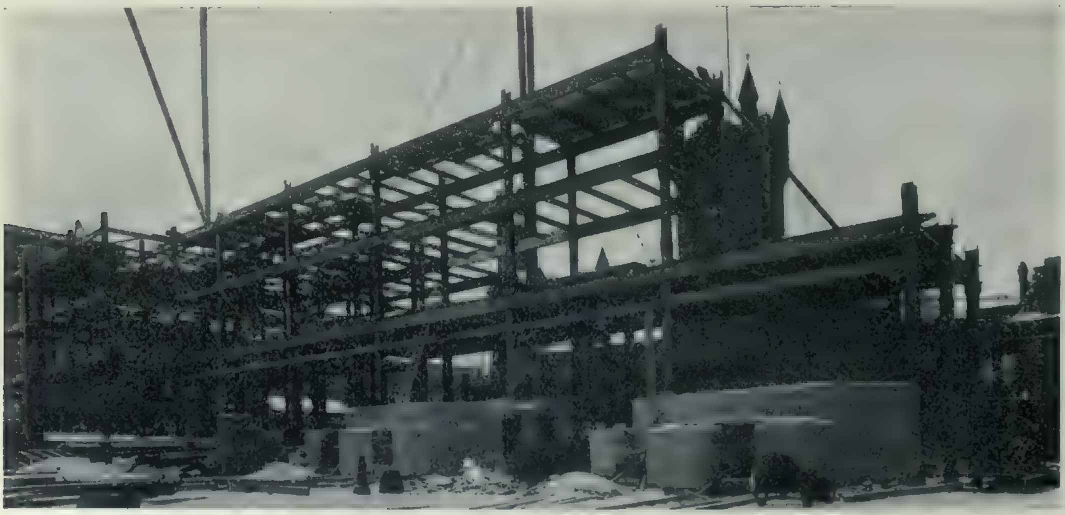
Features of Design and Construction in a Building Especially Adapted to the Economic Handling of Merchandise

THE growing resources of the Canadian Pacific Railway make it imperative that adequate facilities be obtained for the operations of the various departments of the system. With this object in view the company has completed the construction of extensive buildings at Toronto for incoming and outgoing traffic, consisting of warehouse and freight terminal. The site occupies the entire space between King and Wellington streets, and the buildings are situated on the southwest corner of King and Simcoe streets. They have a frontage on Wellington street of 951 ft., on Simcoe street of 434 ft., and on King street of 968 ft. On the King street elevation provision is made for future extension to the warehouse.

Some two years ago freight sheds and transfer platforms were constructed and the present buildings, therefore, complete the company's scheme to provide the required facilities for their operations in Toronto. The new warehouse and freight terminal will handle traffic converging at this point from fifteen tracks and caring for both inbound and outbound freight traffic. The inbound and outbound freight houses have a frontage of 951 ft. on Wellington street, and of 183 ft. on Simcoe street. The section recently added completes a handsome structure, this latest addition being mainly for the accommodation of the Dominion Express Company, operated by the C. P. R.

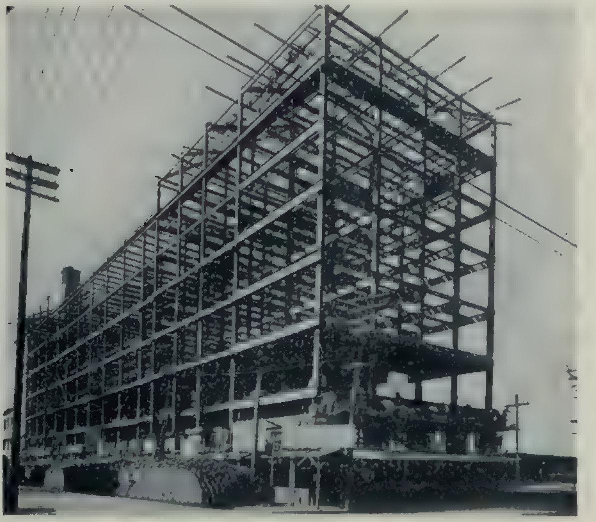
The buildings are uniform in design. They are of steel frame construction, terra cotta and brick. The exterior is faced with Milton pressed brick, and is finished with Indiana limestone trim, belt course and cornices. The height of the buildings from the street level to the cornice on the King street elevation is approximately 100 ft. They are composed of six floors with two pavilions in addition, which latter in reality form an additional storey. The steel work was carried out by the Dominion Bridge Company. Barrett Specification roofing was employed in the buildings, which are fireproof construction throughout, all exterior work being lined with terra cotta.

The floors throughout are the Roebling construction, 4-in. concrete slab with reinforced wire mesh. The finished office floors are maple, hardwood being considered the most suitable for all conditions. The doors generally are oak, excepting a few which are birch with mahogany finish. All elevator doors are fitted with the Norton check. Access to the Dominion Express Building is gained through one main entrance on Simcoe street. The walls of the entrance and the vestibule are done in Jaunna Royal marble, with Terrazzo flooring and marble border. The stairs, which are ornamental iron, are fitted with cement treads. All windows are heavy plate glass. The ground floor is mainly taken up with freight offices and entrances to the transfer platforms. The first, second and third floors will be used as general offices and the fourth floor as executive offices. The fifth floor has also been constructed for general office accommodation, while the sixth floor will be used mainly as a lunch room for the staff. Each floor is adequately supplied with private locker rooms, etc. The section of the building set



Rear view of Express building, Toronto, showing reinforced-concrete buffers.

apart for the executive offices has been handsomely decorated. Around all the corridors there is a chair rail at a height of four feet from the floor, together with painted canvas dado. The general decoration of the walls is buff, the ceilings being done in a cream color. In a number of the main offices the walls are finished in green, with oak trim throughout, excepting the President's offices and the board rooms, which are birch trim with mahogany finish.



Steel frame, Dominion Express Building, Toronto, as it appeared, April 23, 1914.

Heating is obtained from two Maxim boilers, located in the boiler room beneath the freight offices. Steam is conducted to the warehouse and offices through a subterranean pipe connecting the two buildings. All radiators are fitted with the Dunham trap, with modulating valve. Careful attention has been given to the lighting arrangements, which are regarded as ideal. Artificial illumination is supplied by single lights fitted on chain pendants, so spaced that the light is diffused. The window frames and sash on the first floor are kalameined.

View of completed six-storey Express and Freight Offices, C.P.R., Toronto.

The driveways, along Simcoe street, through which access is gained to the various team tracks, are fitted with the Wilson rolling door. The general equipment of the buildings includes the provision of four freight and two passenger elevators. These are the Plunger type, supplied by the Standard Plunger Elevator Company, Montreal.

At the rear of the Express building heavy buffers of reinforced concrete construction have been built at the railroad track terminals.

The buildings combined involve an outlay of more than a million dollars, apart from the cost of laying the tracks and grading work. In point of equipment they are amongst the finest on the American continent.

The general contract for the Express offices, including masonry and carpentry, was carried out by the Peter Lyall & Sons Construction Company, Montreal. Milton Pressed Brick Company, Limited, supplied the face brick and Ontario National Brick Company, Limited, the common brick. The terra cotta was furnished by the Don Valley Brick Works; the reinforced concrete work was carried out by the Crescent Concrete Company, Toronto; the steel was supplied and erected by the Dominion Bridge Company; ornamental iron was supplied by the Dominion Ornamental Iron Company; the marble work was carried out by the J. Gibson Marble & Granite Company, Limited, Toronto; heating, W. J. McGuire, Limited, Toronto; electrical work, E. F. Phillips Electrical Works, Montreal; plumbing, Fred Armstrong Company, Toronto; painting, glazing and decorating, Mr. James Casey, Toronto; roofing, Canada Supply and Contracting Company; metal work, A Matthews, Limited. The general contractors for the freight terminal were the Canadian Stewart Company, Limited, Toronto.

Replacing a 250-foot Reinforced Concrete Chimney

A 250-FOOT reinforced-concrete stack built in connection with the pumping plant of the Torresdale filtration plant on the Delaware River at Philadelphia, is being torn down after it had been replaced by a brick chimney of slightly greater height, built adjacent to it. The reasons for the condemnation were that the stack had an inclination of about 2 ft. towards the pump house; that it swayed about 4 or 5 ins. when subjected to heavy wind pressure; that it was cracked in several places, giving it an appearance of unsafeness; and that it would have wrecked the pumping plant had it blown down in that direction.

When the concrete chimney was built operations had to be rushed so as to get the filter plant ready on time. As soon as the contract had been let in December, 1906, the construction began and the stack was finished May 1, 1907. On days when concreting had taken place the average progress had been about 5 ft. Often the temperature was so low that, when the forms were removed, the concrete had not set, but hung together because it was frozen solid. On other days, especially when the lowest and highest portions were built, the temperature was high enough to permit the concrete to set properly. When the stack was finished the joints between the various stages in concreting were plainly visible from the ground. The concrete, which did not have any coarse aggregate, was mixed in the proportion of 1:3. The sand was taken from a natural deposit close by and had grains from ¼-in. size down.

On the plans and in the specifications it was stated that the stack was to have an offset 104 ft. above the top of foundation. Below this point the outside diameter was to be 12 ft. and the thickness of walls 10 ins. with an interior lining 4 ins. thick and an inside diameter of 9 ft. Between the lining and the outside wall a 4-in. air space was to be provided. At the offset for a distance of 9 ft. the walls were to be 18 ins. thick and above the offset to the head of the chimney 6-in. walls were specified. An ample amount of reinforcement was also specified.

When the stack was razed it was found that the set dimensions had been closely adhered to except for the walls, which were ¾ in. thicker on the north side (that toward the pump house) and ¾ in. thinner on the opposite side than specified. It was also found that the inclination had always been present and that when discovered during construction an attempt had been made to straighten the remaining part to be built. Although the construction joints were plainly visible it was found that the bond between courses was good. The concrete on the north side was found to be the hardest, while that on the south side was the softest. This fact is explained by the supposition that the latter side repeatedly froze and thawed due to the action of the sun, while the opposite side stayed frozen. No concrete work that had been frozen was of a first class quality, but it could not be classified as being directly dangerous. The top part, which had set properly, having been built during April, 1907, was of a very good quality and the progress in tearing it down was only about 3 ft. per day. When, however, the work done during March was reached the progress was increased to 8 ft. per day. In both cases the thickness of walls was 6 ins. except for the head, which was 18 ins. thick and 8 ft. high.

Demolishing the Old Chimney

For demolishing the structure sledge hammers are used to break the concrete in lumps of various sizes. The reinforcing rods are not cut but left sticking up until they can be loosened and thrown to the ground.

The reinforcement consisted of small round rods and square twisted bars of larger sizes. All steel is in good condition, and seems to have been well protected by the concrete.

On the inside of the lining the concrete in several places has sprawled off outside of a number of square twisted bars. This is probably due to expansion of the steel permitting the deformation to act as wedges. Very likely such bars have from the beginning been placed too close to the surface. Flue gases seem to have no disintegrating action on the concrete. Naturally a slight sintering had taken place resulting in a hard interior surface.

As no rungs had been provided on the chimney the matter of climbing to the top of it to begin the work of wreckage was an interesting problem. Two 2 x 4-in. boards 14 ft. long with 1-in. transverse strips served as inclines and chiselled pockets or holes in the masonry served as supports. First one hole about 6 x 6 in. was cut near the bottom of the stack to serve as support for one board which leaned diagonally across the stack. Then the wrecker climbed this ladder, cut a hole in the wall slightly above the opposite end of the board to serve as support for the other piece, put that in place, climbed upon it, cut a new hole and then pulled up the lower piece and placed it in position. In the lower part of the chimney, where the lining was only 4 ins., the holes went clear through, but higher up only pockets were necessary to serve as supports.

During the first day 175 ft. were climbed in this manner, the man in the evening descending a rope by which he was hoisted again the next morning. On the second day at noon he reached the top of the chimney. All told it had taken 14 hours to climb the height of 250 ft. His helper, who was to have been present with a rope and block, failed to appear, so that the climber had to lie down on his planks on the top of the stack and wait until 5 p.m., when finally the rope arrived. A light rope, not sufficient to carry a man, had been brought up by the climber, and by it water and food were sent to him during his long wait. As soon as the rope had been hoisted and the tackle secured the man came down, none the worse for his experience.

The concrete chimney was designed and built by Alphons Custodis Chimney Construction Company; this firm also built the new brick stack and is tearing down the old one. The cost of the concrete stack was $7,500, while the new brick stack cost about $19,000.—Engineering Record.

A Method of Proportioning Concrete

By William B. Hunter*

THE writer submits herewith the results of studies as to a simple method of proportioning the ingredients of concrete so as to insure a satisfactory quality of concrete, and at the same time to avoid the use of an excessive amount of cement.

Several methods for proportioning concrete have been proposed and are in use. These may be outlined as follows:

(1) A careful mechanical analysis of the aggregates and the grading of the same so as to get small percentages of voids, thereby reducing the amount of cement required to a minimum. This may be called the ultra-scientific method.

(2) Arbitrarily fixing the proportions of cement to the aggregates; as 1 part cement, 2 parts fine aggregate, and 4 parts coarse aggregate, commonly spoken of as 1:2:4 concrete.

(3) Adopting a given cement factor—i.e., the number of barrels of cement to be used per cu. yd. of concrete; as a cement factor of 1.80 to 2.10, etc., and adjusting the proportions of the aggregates from time to time to fulfill these conditions.

(4) Determining the amount of cement in excess of the voids in the fine aggregate required to make an acceptable mortar, and the amount of mortar in excess of the voids in the coarse aggregate required to make an acceptable concrete, and then, after determining the percentage voids in the aggregates, proportioning the ingredients so as to fulfill these requirements.

Method 1 may be dismissed without further consideration on the ground of its impracticability.

Methods 2 and 3 are usually satisfactory, and, where the character of the aggregates remains constant, obtain practically the same results as the fourth method. With very little experimenting and the exercise of good judgment, satisfactory results can be obtained. There are, however, objections to these methods, where the aggregates are variable, especially in the percentages of voids contained. For example, assume a 1:2:4 mixture, which is usually expected to give a rich concrete with a considerable excess of cement and mortar over the voids in the fine and coarse aggregates respectively.

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* Assistant Engineer, Board of Water Supply, New York City.

With 40 per cent. voids in both fine and coarse aggregate, which may be considered as a fair average, with 1 part cement, 2 parts fine aggregate, and 4 parts coarse aggregate, there is an excess of 0.2 part cement over the voids in the fine aggregate, and an excess of 0.6 part mortar over the voids in the coarse aggregate, which gives 4.6 parts concrete.

On a basis of 3.62 cu. ft. of cement per bbl., this gives a cement factor of 1.62. This mixture would give good results, and the cement factor is about what is ordinarily expected.

But, with 50 per cent. voids in fine and coarse aggregate, again with 1 part cement, 2 parts fine aggregate, and 4 parts coarse aggregate, there is no excess of cement or of mortar, and there results 4 parts concrete.

It is evident that it would be very difficult to get satisfactory results with this mixture in many structures, such as conduits, thin walls, etc., where the ratio of the superficial area to the volume of concrete is large, and smooth surfaces are required; and yet the cement factor would be 1.86, which would ordinarily be expected to give excellent results.

Again, with 30 per cent. voids in aggregates and 1 part cement, 2 parts fine aggregate, and 4 parts coarse aggregate, there is an excess of 0.4 part cement over the voids in the fine aggregate, and an excess of 1.2 parts mortar over the voids in the coarse aggregate, which gives 5.2 parts concrete.

It is easily seen that with these last conditions, satisfactory results would be obtained; but the cement factor in this case is only 1.43.

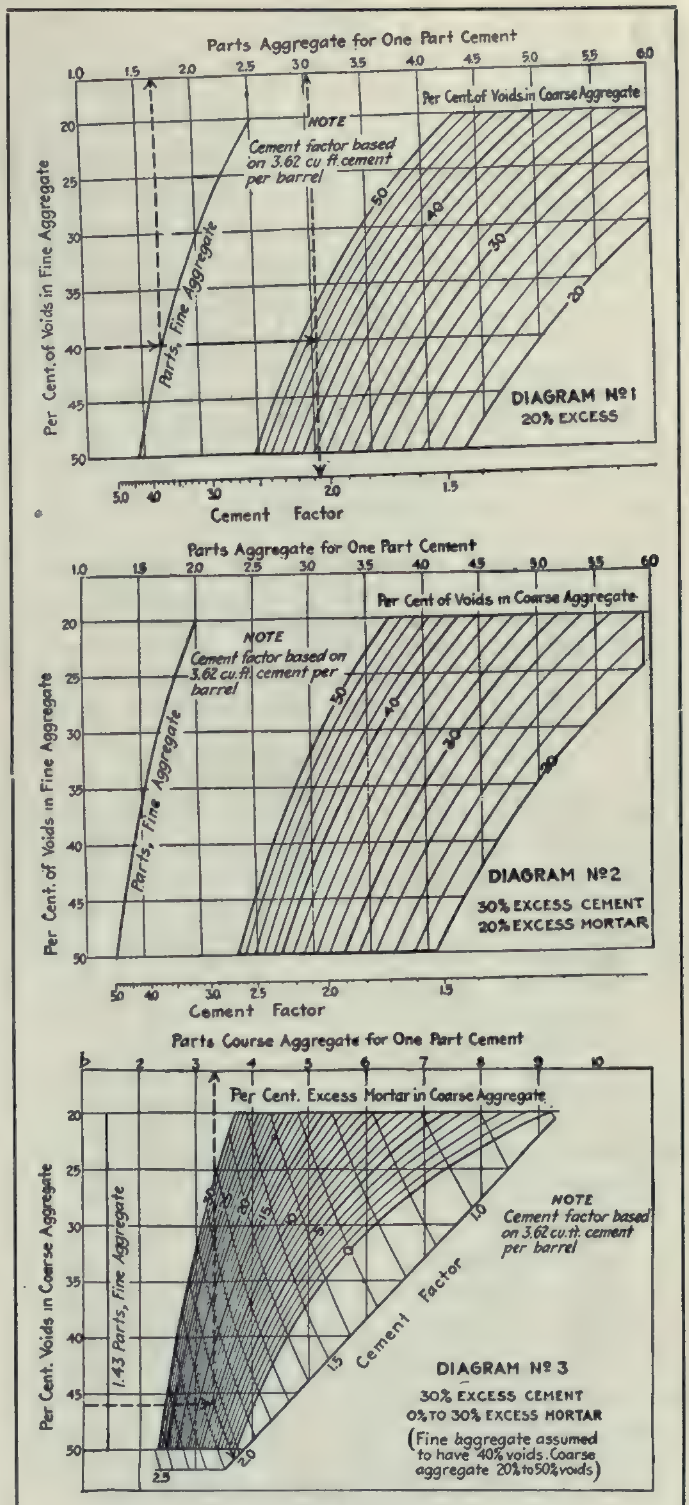
From the above, it is apparent that a high cement factor does not necessarily insure a good concrete, nor does a low cement factor necessarily result in an inferior quality of concrete.

The fourth method is the result of the writer's endeavor to formulate a method which will meet the objections to the second and third, and could be used in conjunction with the first, if it were practicable to impose the conditions of that method. For the purpose of illustrating the use of this method three diagrams are herewith presented.

Diagram 1 is based on the assumption that it is desired to obtain a concrete in which the quantity of cement remaining after filling the voids in the fine aggregate will be 20 per cent. of the gross volume of the fine aggregate, and the quantity of mortar remaining after filling the voids in the coarse aggregate.

Diagram 2 is prepared on the assumption that it is required to have 30 per cent. excess of cement, as previously described, after the voids in the fine aggregates are filled, and 20 per cent. excess mortar after the voids in the coarse aggregate are filled.

Diagram 3 is submitted to indicate the application of this principle where the voids in the fine aggregate can be considered as constant, as is often the case, and the voids in the coarse aggregate are variable. In this case one diagram can be made to cover all percentages for a given percentage of excess cement over the voids in the fine aggregate. The diagram is based on the assumption that the voids in the fine aggregate are 40 per cent., and is computed to give an excess of cement, after filling the voids in the aggregate, of 30 per cent. of the gross volume of the fire aggregate, and 0 to 30 per cent. excess mortar after filling the voids in the coarse aggregate, the voids in the coarse aggregate varying from 20 per cent. to 50 per cent.



Diagrams for determining suitable concrete mixtures.

In diagrams 1 and 2, the curve "parts of fine aggregate" can be used alone where a single aggregate is used.

The accompanying tabulation shows the comparison of results by this method, using Diagram 1, with the standard proportions 1:2:4, frequently used where a rich concrete is required:

Fixed proportions	1:2:4	50	50	0	0	1.86
20% excess	1:1.43:2.45	50	50	20	20	2.53

Fixed proportions	1:2:4	40	40	10	15	1.62
20% excess	1:1.67:3.33	40	40	20	20	1.86
Fixed proportions	1:2:4	40	30	20	30	1.43
20 %excess	1:2:4.8	30	30	20	20	1.30
Fixed proportions	1:2:4	40	30	10	25	1.49
20% excess	1:1.67:4	40	30	20	20	1.55

From this table it will be seen that concrete proportioned on the basis of a given percentage of excess gives uniform results as to the quantity, the proportions and the cement factor varying with the percentage of voids in the aggregates; whereas, with arbitrary fixed proportions, the quality of the concrete and the cement factor vary with the percentage of voids in the aggregates.

Using Methods 2 and 3 (fixed proportions and fixed cement factor, respectively), proportions are usually used which in many instances give mixtures much richer than necessary, in order to guard against getting inferior results from time to time when the aggregates run bad.

The diagrams submitted are merely illustrative of the principle involved, and are not necessarily expected to meet the requirements of any particular class of work, although the 20 per cent. excess diagram would probably give as good results as a 1:1½:3 mixture or a cement factor of 2, and would in most cases require less cement.

Use of Diagrams

Example 1.—To find proportions to give 20 per cent. excess cement and mortar after filling voids in fine and coarse aggregate respectively, when voids in fine aggregate are, say, 40 per cent., and in coarse aggregate are 46 per cent. On Diagram 1, on the left side, find the line representing 40 per cent. voids in fine aggregates; follow this line to its intersection with the curve marked "parts of fine aggregate"; from this intersection follow up to the scale marked "parts of aggregate"; this gives 1.67 parts of fine aggregate.

On the line for 40 per cent. voids in fine aggregate, follow to the right to the intersection of this line with curve for 46 per cent. voids in coarse aggregate; from this intersection, again follow up to the scale of "parts of aggregate." This gives 3.03. The proportions are then 1:1.67:3.03.

To find the cement factor: Read on cement factor scale directly below the last found intersections, and we have cement factor 2.06+.

Diagram 2 is used in the same way as Diagram 1.

Example 2.—To find proportions for 30 per cent. excess cement and 10 per cent. excess mortar, with the voids in aggregates the same as above—i.e., 40 per cent. and 46 per cent. respectively—use Diagram 3. The proportion of fine aggregate is constant in this diagram at 1.43. To find parts of coarse aggregate: On the left side of diagram, on line marked "per cent. of voids in coarse aggregate," find horizontal line for 46 per cent. voids; follow this line to the right to its intersection with curves for 10 per cent. excess mortar; from this intersection, go to the top of the diagram to the scale of parts of aggregates for one part cement; this will give 3.31. The proportions are then 1:1.43:3.31.

For the cement factor: From the intersection of the 46 per cent. void line with the 10 per cent. excess curve, follow parallel to the cement factor curves, and read the cement factor — 2.04 + on the cement factor scale.

In advocating the employment of the percentage of voids contained in the aggregates as an agency in determining the proportions of aggregate to the cement in concrete, the writer is aware that he is proposing a method which has been cast aside by some of the concrete experts. Notwithstanding, he believes that the method herein described is sound in theory and practicability. The writer would further state that in the preparation of the accompanying diagrams he has neglected some small indeterminate coefficients which would not materially affect the results, but which would considerably increase the labor of preparation.

The basis of the computation follows:

1. The effect of the amount of water required to give the mixture a proper consistency in increasing or decreasing the volume is neglected.
2. For the purpose of volumetric determination, the gross volume of the cement is considered as the absolute volume.
3. The volume obtained from given proportions is assumed to be the gross volume of cement and the absolute volumes of the aggregates.
4. The volume of one barrel of cement is considered to be 3.62 cubic feet.

The principal effect of these assumptions is that the cement factors are only approximate, but are believed to be close enough for all practical purposes; and inasmuch as all coefficients are more or less unreliable unless based on experiments with the particular ingredient to be used, it seems best to use none.—Engineering News.

Waves in Road Crusts*

MANY have probably observed the development in bituminous pavements, under traffic amounting to more than a certain minimum, of waves or corrugations approximately at right angles to the line of traffic, and that these waves, where they occur, have an appreciable regularity. This regularity has probably much to do with the suggestion which has been made that such waves be referred to as "harmonic waves," to distinguish them from the more isolated humps and hollows which result from an excess of bitumen in the pavement at one side, or from a settlement of the pavement within a small area, or from something of that nature. Indeed, the theory has been advanced that the harmonic waves referred to may be caused, in many cases, by "harmonic percussion," such as may be set up when a moving heavily loaded vehicle, supported on flexible springs, strikes an obstacle in its path, and attains in its mass a certain rhythmic vibration. This vibration, transmitted through the wheels to the road surfaces, probably produces successive light and heavy stresses in such surfaces, especially when the vehicle is self-propelled. The speaker does not feel that the theory of harmonic percussion is a solution for all harmonic waves, but merely that it is one possible solution of them under certain conditions. He has noticed the appearance of such waves adjacent to an obstacle in the path of traffic when they were not visible away from the obstacle, although the road surface and the road traffic were everywhere, within a reasonable radius, identical. On the other hand, they appear to occur at times when no obstacle such as would set up harmonic percussion is apparent, and in these cases it is quite probable that they are due to excess of bitumen in the road surface, or to improper grading of mineral aggregate for the traffic conditions to be met, or to an improper character of the bitumen, or possibly to some other causes. (Mr. W. W. Crosby.)

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* [Extracts from an informal discussion on "Factors Limiting the Selection of Materials and of Methods in Highway Construction," at a meeting of the American Society of Civil Engineers.]

The speaker cannot accept the theory of harmonic waves said to be due to traffic, nor the beautiful system of harmony of the spheres, for, from practical experience, it has been learned in his department that it is very necessary indeed to watch the output of the mixer carefully. The proportions of stone, of sand, and of asphalt may be all right, but the first run of the mixer will be too rich in asphalt, the middle of the run will be just right, and the latter part of the run will be too lean; consequently, one would have a pavement composed of, for example, 12 per cent., 8 per cent. and 4 per cent. of asphalt, all from the same mixer, notwithstanding that the stone was weighed and measured carefully, as was the asphalt, before either was put in the mixer.

This mechanical failure is often overlooked. It caused so much trouble that the speaker was led to make a careful investigation of the run of the mixer, and it was found that in many cases the asphalt concrete which had been condemned as not being properly mixed owed its lack of uniformity, not to the workmen who were in charge (they had done their duty faithfully and carefully), but to the machine.

In connection with this theory of harmonic waves, there was one very important point made by Mr. Washington which is worthy of more than passing notice—namely, the irregularities caused by improper rolling. The speaker has had considerable trouble in the past, even with water-bound macadam roads. When the causes of the so-called waves are carefully analyzed, it will be found that the trouble lies not in the traffic, but in faulty construction. The first macadam roads built in the United States were rolled with heavy three-wheeled rollers. There never were any waves in those roads. Later, an endeavour was made to reduce the cost of construction, and to that end horse rollers were substituted for the heavy English steam rollers; still later, different types of steam rollers were used, and, last of all, the tandem roller was brought forward as the best. The speaker tried them, and had macadam roads with harmonic waves long before automobiles were used. The real reason for these waves, or hills and hollows, in the road may be found in the method of construction. If the base is not thoroughly compacted, not thoroughly rolled, and not brought to an even and uniform surface, then, if those waves do not appear at once, they will develop eventually. When to this wavy base is applied bituminous concrete which is not uniform in composition, two sets of waves—two sets of hills and hollows—will appear, not due to traffic, but to careless construction.

Highway engineers should not try to dodge their responsibility for poor workmanship by charging it to motor vehicles or to the rhythm with which they travel over the highways when the fault lies in the manner of construction. This must be carefully watched. Careless construction was one of the reasons for the failure of so many penetration roads. The speaker has had experience with penetration roads in which he was told that the distributing wagon had stood for a time at a certain point, and that the hump of bitumen seen on top of the road was due to the fact that the controlling valves were leaking.

In one case coming under the speaker's immediate observation he knew that the wagon had not stopped within 100 ft. of that particular point; therefore this explanation was evidently wrong; hence a series of investigations was made, whereupon it was found that the percentage of voids in the road varied greatly. Where the road was comparatively dense the bitumen appeared in humps on top of it, and disappeared entirely at a depth of 2 ins., and where hollows appeared it was found that the bitumen had penetrated in many cases to the depth of 7 ins. The same quantity of bitumen per square yard of surface having been applied, there was consequently a recurrence of the fat and lean bituminous mixture encountered in the output of the mechanical mixer. A careful analysis of numerous faulty spots, in both broken-stone and bituminous pavements, has convinced the speaker that the varying percentage of voids is a fruitful cause of many so-called failures; in other words, a lack of homogeneity in the mass is the real cause of the wavy surfaces so often seen. (Mr. R. A. Meeker.)

The speaker cannot say much about "harmonic waves" in asphalt or bituminous pavements, but readily agrees with what Mr. Washington has said regarding Mr. Crompton's ideas as to rolling. He believes that waves such as mentioned by Mr. Crompton might occur in some hard homogeneous material, but, with one as plastic as a bituminous pavement, such waves are likely to be due to two causes—lack of cross-rolling and lack of homogeneity of the material. Most highway engineers are familiar with the effect of cross-rolling, and the speaker believes that if roads generally were rolled crossways as well as longitudinally the regular waves would not occur as frequently. No doubt the uniformity of the material, or, in other words, the number of voids in it, has a very great influence on the evenness of wear; and the secret of obtaining a good road, other things being equal, seems to be the even distribution of voids throughout the material. (Mr. D. B. Goodsell.)

The speaker, in company with Colonel Crompton, examined one road on which there were more than 1,000 motor 'buses per day, and found a series of long waves, which occurred with great regularity throughout the length of the road. The speaker believes that improper rolling of the road and the compression of the material are the main factors influencing the formation of harmonic waves. Traffic further develops the harmonic waves due primarily to the vibration of the motor cars passing over them. During the process of rolilng it will be noticed that the material rises in front of the front roller and pushes ahead to a certain extent, finally ceasing to move forward, at which time the roller goes over it. If examined, the road surface will be found to have a marked swell. Colonel Crompton has endeavoured to solve this problem by devising a machine with three sets of rollers instead of the ordinary tandem roller. (Mr. Washington.)

The writer thoroughly agrees with Mr. Meeker and Mr. Washington that the so-called "harmonic" waves are caused more by poor workmanship and materials than anything else. On Diversey Boulevard, Chicago, paved with bituminous concrete in 1911, at a section having a mixed traffic of about 5,000 vehicles per day, evenly divided as to direction, one side has pushed into these waves so that it has become exceedingly rough. The other side is quite smooth. This condition is apparent for only about 2,000 ft. The rest of the highway (several miles) is in perfect condition. It is very evident that defective material or workmanship, or both, have been the cause of this. (Mr. P. E. Green.)

Economy and Efficiency in Pavement Construction*

By H. B. Pullar†

THE economical pavement is a subject of much discussion, but like the proverbial fountain of youth it still remains undiscovered. Many claims have been made for the different types of pavements on the market and almost any promoter, material man or contractor, believes that he can, if given the proper amount of time, convince you that his is the only economical pavement. The truly economical pavement is the one best suited to meet the local conditions which will withstand the ravages of time and traffic with the least possible maintenance, first cost considered.

The old Roman roads with their foundations two or three feet, and in some cases as much as six feet in thickness, were economical roads and pavements for their time, for they not only met the conditions of their time, but have stood the traffic of centuries. To build a Roman road in modern times, however, would not be economical or wise. An American administration attempting to lay a Roman road would probably not only start a vigorous protest of abutting property owners but would find a quick demand for a change in administration. While the history of the old roads of the Roman Empire, France and England, is interesting and they have been of great service in the development of modern type of pavements, they can no longer be used as models.

Americans, with their nervous, progressive and energetic spirit, must solve their own paving and road problems to meet their own particular conditions.

The principal considerations in determining the economical pavement are the traffic and climatic conditions to which the pavement must be subjected, available materials and their cost, assessed valuation of abutting property, and the probable result of the improvement.

Before a pavement is laid the climatic and traffic conditions should be given most serious consideration and should be a big factor in making the final determination. In the large cities where traffic is heavy, granite or wood block are very largely used. This is because these two types of pavement have been found to withstand heavy traffic more satisfactorily. Where the question of excessive noise is not material, the long life and small difference in cost, and the ease of repairs and low cost of maintenance, make granite block the favorite; while on a heavy traffic street lined with office buildings or stores, where the question of noise must be taken into consideration, wood block is constantly increasing in favor. It would be folly indeed to lay a concrete pavement, bituminous or water bound macadam, or any other cheaper type of construction under such conditions. In considering the traffic conditions to which a pavement must be subjected it is always necessary to take into consideration the probable increase in traffic after the pavement has been laid, and in many instances it is advisable to take traffic census for the proposed improvement. It is not uncommon for the traffic of a road or pavement to double in volume after the improvements are made.

Another very important matter in considering the traffic conditions, is the kind of traffic. Where horse-drawn traffic prevails, a pavement should be made to aid this class of traffic; and where motor traffic prevails, a different type of pavement entirely may prove to be the most economical. Probably one of the best examples of this kind can be cited in Wayne County, Michigan. Almost everybody interested in paving has heard more or less favorable comments as to this large mileage of concrete roads. Cement manufacturers and promoters have advertised these roads from one end of the country to the other, but in trying to convince you that concrete roads will be the most economical pavement for you to lay and in telling you about these Wayne County roads they usually forget to give all the facts, and fail to realize that because in Wayne County or some other place concrete has given successful results, it will not necessarily prove to be successful for your own work. The traffic on the Wayne County roads has been reported as being over eighty per cent. motor traffic, and a large per cent. of this motor traffic is pleasure vehicles. The roads are and have been constructed by the most up-to-date methods and repairs are made immediately any defects appear. Were these conditions reversed, and the concrete roads in Wayne County compelled to withstand over eighty per cent. of horse-drawn traffic or even a much higher per cent. of heavy commercial car traffic, they would probably not prove to be the most economical, and the reported low cost for repairs and maintenance would be considerably increased.

Climatic Conditions

Climatic conditions should be given consideration when determining upon the most suitable type of pavement. In England it was found that asphalt pavements laid similar to those in America deteriorated very rapidly, and the cause was found to be the heavy fogs. A higher percentage of asphalt was used to overcome this trouble and more successful results were obtained. The southern part of this country requires a bituminous material of different consistency than that used in the northern section.

Bituminous pavements to give most successful results must have suitable drainage, and while this is true of other pavements it is specially true of all bituminous work. The climatic conditions of Michigan permit the use of many and various types of pavements, and they are not as important a matter as in other parts of the country.

The availability of materials is often given but slight consideration in determining the type of pavement to be constructed, and yet it is of the utmost importance in some localities. Where good sand is available at a low cost and where other conditions are equal, how foolish it is to import brick from another state in preference to laying sheet asphalt pavement, which is composed of about eighty per cent. of sand, whereas the reverse would be true if it were necessary to import sand into a town in which there is a brick plant turning out high quality brick. There are conditions in different cities which make it advisable, even at a much higher cost, to favor one type of pavement over another, but where the truly economical pavement is desired and other conditions are equal, the availability of materials should be given careful consideration.

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*Paper presented before the League of Michigan Municipalities.

†Engineering Chemist, Detroit, Mich.

In determining the most economical pavement the assessed valuation of the property is too often considered to be of minor importance, and politics and real estate promoters are frequently the cause of sheet asphalt pavements being laid out in the country, while the old unreliable water-bound macadam pavement remains in the heart of the city. We find many instances where expensive wooden block pavements are laid on light traffic residence streets with heavy assessments made against the abutting property owners, who can ill afford them, while in the main business streets a cheaper type of construction is used with a heavy maintenance coming out of the general taxation fund. This practice is certainly contrary to all ideas of economy, and there has been much waste of publis funds in cities where such conditions exist. A careful consideration of the needs of a street and the assessed valuation of the abutting property will not only result in better streets, but will cause a much lower general maintenance charge on all paving in the city and a more equal and just distribution of the paving fund.

The medical profession, with its great scientists and students, is continually finding new cures for what have been previously considered incurable diseases. Likewise the engineering profession, by its scientific studies and research work, will continue to overcome the numerous and difficult problems of paving construction. The economical type of pavement is distinctly an engineering problem and its solution for any particular street or locality will depend upon the efficiency of your engineer. The time is coming when the city engineer will be given more authority to direct and more opportunity to study and work out to advantage his paving problems. A successful manufacturer would soon lose his business and turn his dividends into losses were he to employ a new superintendent each year; as he would, also, if he should employ a capable superintendent to look after his business and then only spasmodically assist him in his work, or fail to give him authority to go ahead. So the choice of the economical pavement must be left with a capable engineer, receiving a big compensation and with full authority to direct his work, and in this he should receive the co-operation and help of all officials and citizens.

Coming Types

While I have endeavored to give you a general idea as to some of the important features to be taken into consideration when deciding upon the economical pavement for your city or town, I will endeavor to give you a short description and history of what we believe to be one of the coming types of economical bituminous construction. This is known as the open type of asphaltic or bituminous concrete.

With the advent of the automobile and the demand for a more permanent type of construction than the water-bound macadam, the bituminous macadam laid by the penetration method was one of the first to be considered and has been most extensively used. For a time it seemed to have solved the problem, but failures have been too frequent and costly. While there are many good bituminous macadam roads which were constructed by the penetration method, the many small details which must be carefully looked after in order to get successful results have made the proportionate chances of failure so numerous that it is always with more or less uncertainty of results that a penetration job is constructed. The principal causes of the failure of bituminous pavements laid by the penetration method are the impossibility of thoroughly coating each particle of stone and the segregation of the stone, making it impossible to obtain an even distribution of the bituminous material. The result of this is that there are numerous spaces in the road which allow water to penetrate, causing the pavement to disintegrate rapidly.

Bituminous Concrete

Another type of bituminous pavement which has found great favor, is the bituminous concrete, which is a mixture of asphalt, sand and stone. This type of pavement would find greater favor were it not for the fact that certain patents to cover practically all mixtures of stone and sand have been held valid in some of the courts; and on account of the undesirability of getting into any patent litigation cities have hesitated in adopting this type of construction.

Because of the uncertainty as to the results obtained from the penetration work and because of the desirability of getting a cheaper type of bituminous pavement than the asphaltic concrete or sheet asphalt, the open type of asphaltic or bituminous concrete has been developed and has met with much favor in different sections of the country. This type of pavement, however, is not a new one, having been used many years ago with a tar binder. The pavement consists of a mixture of stone and bituminous cement acting as a binding medium.

The stone is heated to a suitable degree of temperature, depending upon the bituminous material used, and then mixed with bituminous binder in suitable proportions. It is laid similar to sheet asphalt or asphaltic concrete. The mixture is laid from 2 to 3 inches in thickness and properly rolled. After rolling there is applied a squeegee coat of pure asphalt cement and while the coating is still hot stone chips are thrown over the surface. The whole pavement is then re-rolled so the squeegee coat is forced into the voids, making a tight, uniform, waterproof and durable surface. Heating the stone and then mixing in asphalt so that each particle is thoroughly coated, prevents the trouble which causes so many failures in the penetration method and prevents any segregation of stone.

The city of Lansing last year tried out this type of pavement on some of the principal streets with most excellent results at a very low cost. On account of the results obtained at Lansing, the State Highway Department of Michigan will put in a strip of this same type of pavement in Oakland County, which is an extension of the Woodward Avenue pavement of Detroit. This section of pavement will join the concrete road of Wayne County and will afford an excellent opportunity for a comparison of the two different types for the same traffic. There are a number of other cities in the state which have already laid considerable yardage of this open type, and which contemplate laying in the future a large amount of this work.

The open type of asphaltic concrete pavement is free from infringing on any patents, thus removing any cause for litigation. Although there are about 35 per cent. of voids in the mix as it comes from the mixer the stones key in together giving the wearing surface stability, thus preventing shoving and rutting. In fact, the finished pavement is similar to water-bound macadam with the exception that each stone is bound together with asphalt cement. The asphalt cement prevents any dislodgement of the stone from either horse-drawn or motor traffic.

The first cost of this pavement is very nominal compared with other types, being slightly higher than that of the penetration and considerably less than the closed type of bituminous concrete or sheet asphalt. With the average conditions in Michigan these pavements can be laid by contractors for from $1.10 to $1.40 per square yard, including 6-inch concrete foundation, but if the pavement is put in by the day labor plan, under the supervision of the city engineer, the cost should be considerably lower. In fact, I believe the total cost of the paving at Lansing did not exceed $1.10 per square yard, and the city used crushed cobble stone instead of limestone, which added considerably to the expense.

The open type asphaltic concrete pavement, after traffic has been on it for some time, looks almost the same as the closed type, or like bitulithic. It is easy to repair, pleasing in appearance and makes a sanitary and noiseless pavement. There many cities and towns throughout Michigan, especially in the residential sections, where this type of construction would be advisable. I think it would prove to be the economical pavement and I believe that it will constantly grow in favor with engineers and officials in charge of paving work.

There is another item to be taken into consideration in discussing the economical pavement. No type of construction and no materials, no matter how high the quality or how successful they have been in other places, will be satisfactory in any locality unless they are properly constructed. Just because a pavement or a particular type of construction has given successful results in one town or one locality is no indication that it will be equally successful in your city or town unless every precaution is taken to see that the numerous small but important details are carefully looked after. The best of materials cannot give good results unless properly handled, while better results can be obtained with poor materials properly applied.

It is not, by any means, always economical to award the contract to the lowest bidder and a difference of 5, 10, or even 25 or 50 cents per square yard in the original cost may in the end prove most economical.

In conclusion, I would state that the economical pavement of to-day is not any particular type or any particular material, nor is it a pavement put in at any particular cost. It is a pavement carefully selected after an exhaustive preliminary examination by an efficient engineer to best meet the demands of the particular locality in which it is to be constructed. It is a pavement laid in direct accordance with the requirements of carefully prepared specifications, which should be reasonable and just to both the city and contractor. It is a pavement in which only the most suitable available materials for its particular type of construction are used; a pavement laid under the direction of an efficient and capable engineer, with authority to direct and supervise the many details of construction and to appoint inspectors for their efficiency and ability to carry out his orders, rather than for their ability to obtain votes at the next election. The city or town in which this condition exists, while it may continue to have a failure now and then, and while it may not find the one economical pavement, will come nearer to solving the problem and satisfying the tax payers, to whom all public officials in the end must look for commendation.

The Meaning of "Macadam"

By Major W. W. Crosby*

GENERAL agreement as to the meaning of the word "macadam"—commonly used to refer to a type of road surfacing—would prove of great convenience. The writer does not know that there is at present much diversity of opinion as to what is covered by the term, but it has been stated to him that no general agreement has been reached on this point; that in more or less numerous cases where experience has been limited to the use in construction of, say a few kinds of broken stone, it seemed that little, if any, thought had been given to arriving at the limits of meaning of the term "macadam," it being granted that it applied to the work in hand; and that accordingly it might be wise to discuss the possibilities of its definition and to suggest one such as a concrete starting point for the discussion.

Any definition of "macadam," meaning a type of road surfacing, which limits the material to be used for its construction to crushed stone would, the writer thinks, be too narrow to be either correct or convenient. McAdam, the engineer from whose name the term is derived, himself used no "crushed" stone nor did he confine himself even to broken stone. He specifically refers, in his "Remarks on Road Making" (London, 1820) to the use of "gravel," "flint," "limestone," "whinstone" and "large pebbles mixed with sand," and says: "Excellent roads may be made with any of these materials." Then he later lays down certain principles for the use of "different materials," condensed extracts from which are quoted below in the order he gives them:

> The size of the largest pieces of road metal should not "exceed an inch in any of its dimensions."
>
> The road (i.e. road crust) ought to be considered as an artificial flooring or roof over the foundation, which latter really carries the bonds and to that end, must be kept dry.
>
> The admixture of earthy or other fine material to broken stone is injurious and a mechanical bond or interlocking of angular pieces of road metal is necessary. This should not be discouraged or interfered with by the presence of fine material.
>
> The road metal should preferably rest on a firm, but resilient, foundation, rather than on a hard rigid one such as ledge or rock paving.
>
> The thickness of the road metal should be no greater than necessary to preserve its integrity as a roof to keep the foundation dry.

Throughout the whole book may be found many references to the use of gravel by McAdam, his criticisms of it as well as of various stones, and his suggestions for the use of each.

The point the writer wishes to make is that our term "macadam," considering its derivation, means the attainment of certain results based on the observance of definite principles rather than the use of particular materials or methods.

McAdam had no steam rollers, no stone crushers, and the available materials for his road metal were limited to stone and gravel. Had good slag, for instance, been as available then as to-day, is it reasonable to suppose that so practical a man would have ignored its possibilities?

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*Chief Engineer, Maryland Geological Survey, Consulting Engineer, Baltimore, Md.

It seems to the writer that if we recognize the principles of McAdam, referred to briefly above, and also the wider resources for both materials and machinery now open, a proper definition of our term may be made as follows:

> Macadam is a road crust composed of gravel, shells, slag, broken stone, or similar materials, in which the largest particles do not exceed a certain maximum size (dependent in any case, to some extent on the quality of the material used but generally about two inches for the longest dimension), whose particles, having a size preventing their passing a ¾-in. ring, are compacted together so as to be interlocked and mechanically bound together to the utmost possible extent, and whose then remaining voids or interstices are filled, by the aid of water, with smaller particles and fine material from the same or similar sources. True macadam has no particles in the surface exposed to travel whose size is so great as to render them unstable under horse-drawn vehicular travel. Macadam built on top of an artificial foundation of paving is usually called "Telford" or "Telford Macadam."

In case a general acceptance of such a definition is had for "macadam," several related or subsidiary terms may be most conveniently used with an increase of clearness in their use.

For instance, "shell road" may be used to designate a road surfaced with dredged shells which are generally mixed with sand, silt, etc., while "shell macadam" would differentiate the surfacing built with clean shells, compacted and then filled (as to its voids) with only the necessary amount of sand or fine material. "Gravel road" would mean a road with a crust of unscreened or "bank" gravel, while "gravel macadam" would indicate the adherence to the principles of McAdam. A "slag road" would be built of slag from the pile, unscreened. "Slag macadam" would indicate that breaking and screening the material had taken place in some way. Further along this line, the term "bituminous gravel (or shell or slag or broken stone) macadam" would then logically be a most convenient term for differentiating such a surfacing built by the penetration method from one built by the mixing method (a "bituminous concrete").

It seems to the writer that it is up to highway engineers to adopt promptly such reasonable nomenclature in their work as will indicate by its saving of breath and ink their appreciation of the engineering demands, as well as those of the times, for efficiency.—Good Roads.

Value of a Library in an Engineering Office

Arguments in Favor of Converting the Dusty Pile of Pamphlets and Periodicals into a Central Bureau of Useful Information

By L. B. Krause[*]

WHY should an engineering firm build up an office library? The answer to this question is almost unanimously agreed upon by professional men of highest standing, and the reasons why may be briefly stated as follows:

First. The success of engineering work depends on accurate information, for information is as necessary a tool in the examination, design and construction of engineering enterprises as the mallet and chisel are in the work of an artisan. A knowledge of the experience of others, gained through the medium of print, is invaluable in producing the best results to be achieved in any line of work.

Second. The competitive element in modern business requires that everyone should know, if possible, what everyone else is doing, and the best way to find out is by means of printed information.

A prominent engineer, head of an industrial laboratory, recently stated in an address that industrial laboratories "should each one be developed around a special library, the business of which should be to collect, compile and classify in a way to make instantly available every scrap of information bearing upon the materials, methods, products and requirements of the industry concerned"; while a noted water supply engineer, writing upon the work of a consulting engineer in a recent periodical, states that the consulting engineer "should have a specialized library of all waterworks literature, carefully filed and indexed for ready reference, and that if he be wise he should expend a good deal of time and money in tabulating data, forming a data file for ready reference on all of the more independent subjects that are likely to come before him."

Methods of Building Up an Office Library

Taking it for granted, therefore, that engineers in general are convinced of the value of collecting printed information bearing upon their particular lines of work, the more serious and vital question is, How can this information be most economically collected and efficiently administered? Or, in other words, What are the best methods of building up an office library?

The first step in the building up of an office library is the concentration or collection of all the printed material available in the office in one place. This is exactly what is not done in a large number of offices. Books, pamphlets and other information are scattered among the various members of the organization, who treat them as personal property and preserve them in their private desks as carefully as a squirrel hides his store of good nuts. The policy in many offices in regard to information seems to be to hang on to everything of value for one's personal use, regardless of how much value the information might be to another member of the organization and also regardless of the fact that the material has been paid for out of company funds. The ethics of such procedure is exceedingly questionable, for it certainly is self-evident that both material and time which are paid for by an organization should be used for the best interests of the organization as a whole.

Too much emphasis cannot be placed upon this first principle of the successful office library, namely, that all material should be shelved in one place, making it of equal access to all members of the organization.

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[*] Librarian, H. M. Byllesby & Company, Chicago.

Technical Periodicals and Indexes

The next important step is the proper preservation of technical periodicals. The failure to preserve, by binding, files of valuable periodicals is another sin of omission to be laid at the door of many offices. Single numbers are lost through the carelessness of the office force or are rendered useless by items having been cut out according to the interests of the various readers. It is certainly legitimate for a man to clip or lose the copies of a periodical for which he personally subscribes, but it is certainly not legitimate for him to mutilate a file which should be preserved for the benefit of the whole office.

The question has arisen whether it is not more advisable to cut up periodicals and preserve only articles of special interest than it is to bind the volumes, which take up more shelf room. While it may be advisable to clip certain articles of interest from miscellaneous journals whose general run of material is only of occasional interest or value, on the whole the practice of clipping and filing only portions of the best technical journals is a short-sighted policy and not an economical or efficient one for an engineering office. No engineering office is prophetic enough to foresee exactly what information needs to be cut out and preserved for future use when one considers the variety of valuable material found each week in the leading technical journals.

Something may be said in favor of articles being clipped for a personal file by individual engineers who subscribe only for two or three journals and whose range of interests is bound to be more limited than those of a whole office staff. One of the best filtration engineers in this country has for years cut up the Engineering Record and mounted certain articles on stiff manilla sheets and filed them by subjects in pamphlet boxes. But even in such an individual case is there not danger of a need for information arising which an engineer has not foreseen and in which a bound file of a periodical would prove invaluable? There must be taken into consideration also the time consumed in selecting, clipping and filing, which would be eliminated if the volumes were bound. If aid is needed for quick location in the bound volume of special articles of interest, a brief subject-card index can be easily prepared.

In addition to binding up sets of periodicals for the office library there should be purchased the general indexes to technical periodicals, as the "Engineering Index Annual" and the "Industrial Arts Index," and any cumulated indexes to the individual journals of which the office has a file. These general indexes will, of course, give references to many periodicals not in the office library, but they render the valuable service of directing attention to information not at hand but which can be easily procured from the large public or engineering libraries of various cities.

What to do With Pamphlets

Every engineering office receives a quantity of pamphlet material which is either not preserved or which soon grows into a dusty pile of unsorted material. There are only two ways of disposing of a pamphlet—either put it into the wastepaper basket or treat it as worthily as a book, for the value of any pamphlet is not to be determined by its size or binding but by the quality of the information which it presents. The chief objection to a pamphlet, no matter how valuable its information, is its lack of durability; the leaves are generally poorly fastened together and it soon becomes dog-eared and torn. Two methods of preservation may be used—either put each individual pamphlet into a binder, such as the Gaylord pamphlet binder, or use pamphlet boxes in which to group pamphlets on certain subjects and stand them on the shelves with the books treating of the same subjects. Individual pamphlet binders are, in the opinion of the writer, to be preferred, as they give a pamphlet a stiff cover, which makes it more neat and durable. The general rule governing the care of pamphlets should be that a pamphlet worth keeping should be treated just as a book is treated.

The vertical file has been used for taking care of pamphlets, but it seems to the writer more advisable to bring all material on a subject together on the shelves than to have it filed in two places. The vertical file is the best method of filing manuscript and typewritten data which supplement the material found on the library shelves but which cannot be conveniently put upon the shelves, because of their form.

Other Material to be Included in the Library

The library in an engineering office should never be limited to collecting books and pamphlets only, but should be built up in accordance with the broadest idea contained in the word library, namely, information of all kinds in any form which may be useful in the work of a particular organization. This means not only books, periodicals and pamphlets, but also photographs, trade catalogues, manuscript data of general interest, specifications, and valuable notes accumulated in connection with the specific work of the organization. It is a lamentable fact that the work of many offices is handicapped by want of co-operation among its members, shown in a selfish withholding of information by which "the other fellow" could profit and to which he is lawfully entitled. There is also a tremendous waste of both time and experience, which means money, due to the failure to put on file for future reference all data which have been accumulated in years of study and work by the employees of an organization. In some cases where an effort has been made to file such data their future usefulness has been reduced to a minimum by want of an adequate system of filing under competent supervision.

It is a self-evident fact that only continuous and competent supervision can assemble and make valuable such a variety of information. It cannot be done by the average office helper, either office boy or stenographer, and it is not economy to use the services of one of the engineers, whose time is more valuable along the line of his special knowledge, and who, also, has no familiarity with methods of library work. The failure of many engineering offices to realize the value of building up a library is due to the fact that the work is put into the hands of someone in the organization who does not know how to collect information or how to make it quickly available after it is obtained. The office stenographer who is busy with other work has not the time, nor does he know how to do it even if he had the time; while the engineer who is competent to pass upon the merits of the desired information after it is obtained does not know in many cases just where to get the information from outside sources. The writer knows of concrete instances in which engineers whose time is worth a large sum per day have spent a number of hours in locating technical information which could have been found in a much shorter time by a trained librarian, the cost of whose services by the month would have been equal only to the market value of the expert engineer's services by the day.

"The Librarian Knows How"

The argument for the employment of a trained librarian can be briefly stated in four words—the librarian knows how. The librarian knows how to procure valuable information contained in Federal and State reports, knows how to keep up with the literature of the engineering profession and how to obtain desirable printed data which cannot be purchased and which must be obtained from private sources. The librarian knows how to use all kinds of indexes, how to use quickly the facilities of large city libraries, how to catalogue and index according to standard practice, so that no time or money is wasted in experimenting with original systems; and last but not least, always has a place for everything and everything in its place. The librarian also makes a business of knowing about all the work of the office and co-operates with each department in touch with what another department is doing. The librarian also keeps up with the field of print, which the engineer is too busy to look over for himself, posts him on what he ought to know, and, in brief, becomes to the office a walking guidepost and a living index.

Should the question arise as to whether there is work enough in any one office to keep a librarian busy (a condition which the writer seriously doubts), it might be well to state that the educational qualifications of librarians make it possible to use them on a variety of work.

In conclusion, it may be stated that it seems a short-sighted policy for a large engineering office to fail to add to its staff a librarian who can make readily accessible information of inestimable value in the successful prosecution of its work.—Engineering Record.

Control of Reinforced Concrete Construction*

By W. K. Hatt†

A NUMBER of casualties have attended construction in concerte. A sudden collapse of a portion of a reinforced concrete building in a large city, attended with loss of life of workmen, generates in the public mind a fear of concrete construction; and a prospective builder is likely to resort to a less permanent and less fitting style of building because of the uncertainty. He knows that a concrete building is serviceable and permanent after the cement has set, but he fears the risk arising during construction.

Structural engineers on the other hand know that the percentage of failures is small, and the accidents to be avoidable.

Dangerous conditions in reinforced concrete construction arise from (1) inadequate designs; (2) defective materials, and (3) unfavorable weather conditions and lack of care under those conditions.

All of these elements may be, and are, controlled in the larger cities by building codes and active inspection. For instance, in the city of Chicago, which has an unusually efficient and watchful building department, there have been no serious failures of reinforced concrete buildings under construction. In this city designs are checked over very carefully to see if they conform with the conservative practice established by the building code of that city.

It is in the smaller cities, that are large enough to demand permanent buildings but without building codes, that the most dangerous conditions obtain.

The building codes are thought to be too conservative by some designing engineers of companies interested in the sale of materials. For instance, while these codes generally permit 16,000 pounds stress per square inch upon ordinary reinforcing steel, some designers will increase this to 20,000 pounds where the code does not prevent, and under circumstances where the sale of the material depends upon a low total price.

Many buildings have been erected under designs that are not conservative and yet have given good service. Their construction has been under favorable conditions with reference to cement, sand, weather conditions, and skill of workmen; and the lack of factor of safety in design has been counter-balanced by the increased factor of safety in materials.

Codes, however, must recognize average conditions. The architect or structural engineer or commercial firm supplying material, who has drawn upon the factor of safety in design, and then has met unexpected conditions in the materials, weather conditions, etc., and has a failure on his hands, is certainly in a weak position.

The larger number of failures of concrete buildings occur during the late fall when the low temperature and wet weather prevent the cement from hardening properly. At this time, too, the owner is anxious to get in the building. Every one is in haste; forms are struck before the concrete is hard enough to support the floors above; the roof, which is often the weakest part of the design, is being covered with cinders, into which the rain seeps. Instead of weighing 45 pounds per cubic foot, the weight of these cinders may run up to 100 pounds per cubic foot. Then, too, the plumber may seriously overload a portion of the floor with piles of pipes, may even remove a form support. Under these conditions it is no wonder that failures occur. In the presence of these unfortunate failures a designer who has furnished a conservative design is in a strong position.

The writer has investigated and made reports upon several failures in which it has been necessary to criticise the design. In some of these cases the architect has originally made a conservative design with sufficient materials and proper connections. The sales engineer of a company supplying steel has afterward prevailed upon the architect and owner to allow a substitute design. The latter is shaved down to the lowest limit, involving high stress in steel, short laps for bond, and defective continuity. While the substitute design will save in the cost of steel, the per cent. saved on the cost of the entire building is usually small and will not justify the risk of the entire structure.

While recognizing the fact that methods of construction and dimensions of structures proceed partly upon experience and the desire for economy, the writer urges that, in the case of reinforced concrete, designs should follow building codes and the report of the conservative practice as fixed by the Joint Committee on Concrete and Reinforced Concrete which has recently been adopted by the American Society of Civil Engineers and the American Society of Testing Materials.

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* The Ohio Architect.

† Professor of Civil Engineering, Purdue University, Lafayette, Ind.

The standard designs of some of the constructing companies are also reliable and conservative. A special mention might be given to the Kahn standards of the Trussed Concrete Steel Company, of Detroit, and those of the Corrugated Bar Company, of Buffalo, N.Y., for the dimensions of beams and girders of ordinary floors and roofs.

The codes, however, are naturally behind hand in respect to the newer forms of construction, such as the so-called "flat slab" design.

In construction with new materials the tendency is to follow forms that have been developed for old materials. Thus the first reinforced concrete buildings used the old wooden construction of girders, floor beams, and slabs between the latter.

In another line the first railway coaches were patterned after stage coaches.

Reinforced concrete, however, is monolithic and continuous, not discontinuous like the old constructions.

The flat slab designs omit girders, and floor beams. There is a continuous slab over the entire floor, and it rests upon and is monolithic with the expanded heads of the columns.

The steel is disposed in either a four-way system or a two-way system.

These constructions are usually patented. Advantages are (1) the better lighting of the room, (2) the increased head room, (3) decreased storey height, (4) more simple installation of sprinkling systems, (5) simpler form work, and (6) a construction more in keeping with the material.

The construction is generally considered more suitable for loads up to 500 pounds, and column spacing up to 24 feet than for larger loads and wider spacing. When the panel becomes rectangular instead of square, the long side should not exceed the short side more than 1-3 part.

The depth of slab should be at least 1-30 the span between column centres.

The design of the expanded head of the column needs attention. It should be stiff.

The steel is in the bottom of the slab at the centre of the panel, and passes up to the top of the slab near the quarter point of the span.

The steel that passes from one panel to another should lap well over into the next span at least 60 diameters beyond the edge of the column cap. And where both bars are counted upon as reinforcing over the column, they should keep well up in the top of the slab over the column, and run 60 diameters beyond the quarter point of the span.

The amount of steel should be about the same in the various patented arrangements for given loads and spans.

Over the column head, the amount of steel should be sufficient to resist an external bending moment equal to 1-15 WL (for interior square panel); where W equals total load, live and dead, on panel; L equals span centre of centre of column along direct line.

The British Government has appointed a Commission to proceed to Canada and Newfoundland to enquire into the possibility of opening up new sources of supply of mining timber for use in the coal mines of Great Britain.

Painting Concrete Surfaces

A PAPER by H. A. Gardner, read before the American Society for Testing Materials, presents data tending to show that pure oil paints can be used satisfactorily for painting concrete surfaces either for decoration or for dampproofing, provided the surface is first properly primed.

Probably too much importance has been attached to the alleged destructive action of lime found upon cement surfaces. It is well known that setting Portland cement develops free lime, but the amount to be found upon a Portland cement structure should be considered as negligible in most instances, so far as it might affect a well-designed paint. If indeed it is advisable to neutralize this small amount of lime, previous to painting the cement surface, such a result is not to be properly accomplished with an organic substance, but rather with an inorganic material which readily reacts therewith. A solution of zinc sulphate has proved most efficient for this purpose, and has been used for many years with practical results, especially upon freshly laid cement.

As the result of a series of tests to determine the durability of various types of paint upon Portland cement surfaces exposed to the weather, Mr. Gardner draws the following conclusions:

Opaque white pigments, such as basic-sulphate white lead, basic-carbonate white lead, zinc oxide, and lithopone, were present in the paints which gave the best results. In some of these paints, there was also a percentage of inert pigments, such as barytes, asbestine, whiting, china clay, gypsum, and silica.

Concrete surfaces can be decorated with excellent results through the use of high-grade oil paints. When the cement surface is freshly laid and is damp, such paints may be safely applied after treating the cement with a zinc sulphate primer.

The Proposed Civic Centre at Vancouver

IN view of the open competition for competitive designs in connection with the development of the new Civic Centre at Vancouver and the extensive scheme under consideration, some details concerning the proposed buildings will be of interest.

To form the Civic Centre the following buildings will be grouped: City Hall, Public Hall and Auditorium, Public Library, Technical College, Museum and Art Gallery. It is proposed that the City Hall be erected first. In all probability the construction of the Technical College and Public Library will be undertaken soon afterwards. Next in order will be the Public Hall, to be followed by the Museum and Art Gallery. The City of Vancouver and the Provincial Government own an area of approximately eight acres which will probably form the nucleus of the scheme. Designs must be addressed to the Secretary, Vancouver Civic Centre, Board of Trade Rooms, Molson's Bank Building, Vancouver, on or before 12 o'clock noon, November 31st, 1914. The committee's award will be made not later than December 31st, 1914, after which date the designs will be exhibited in Vancouver.

General Points on Moving Large Structures*

IN preparing a building or structure of any kind for raising and moving it will be necessary to make a careful study of the structure. The weight should be carefully estimated, the general construction of the building should be understood, in order to know the distribution of loads on present foundations. The character of ground over which the structure is to be moved should be considered, especially if the building is of a heavy type.

After the above points have been carefully considered, a layout is made showing the manner of picking up the structure, which is done in the case of a brick or stone structure by inserting either beams or heavy cross timbers at proper places to take the load without causing strains in the main structure, when the building is raised. The main principle in raising structures is to keep conditions as nearly as they were, when on original foundations.

In the case of steel structures, special consideration is given to each individual case and no set method can be laid down for the work; however, the general principles are applicable to all structures.

The following sketch, Fig. 1, shows the manner of building a blocking and the setting of timbers and arrangement of screws for raising a structure. Regularity and care must be used in building the blocking and in the manner of setting the screws and locating cross-timbers for taking up the building.

After the building has been raised the required height and it is desired to move it, oak runs are built and the building lowered on rollers which bear on 6 x 8-in. oak runs below and on roller planks above, after which the jackscrews are removed. This is shown by the sketch, Fig. 2.

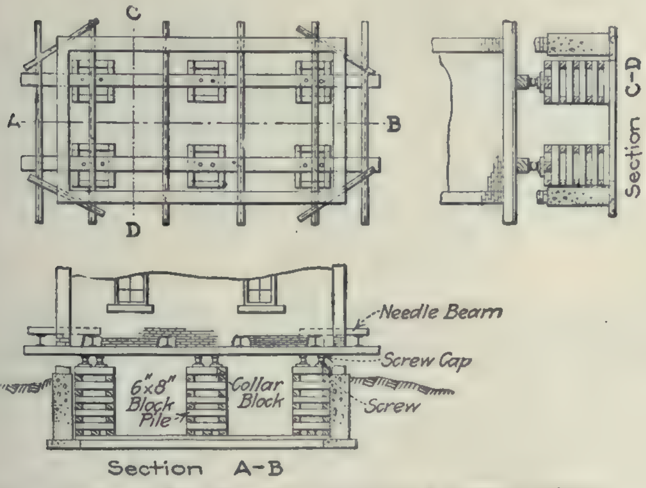

Fig. 1—Arrangement of blocking, timbers and screws for raising a building.

In case it is desired to turn the building slightly, the rollers can be "cut," that is, set at a slight angle to the general direction and gradually brought over to proper line. Cutting the rollers is a term used for knocking one end of the roller slightly with a hammer to change the general direction of the structure being moved. However, it is sometimes necessary to actually cut the rollers with a saw. Where the building is to be given a quarter or half turn, or a complete turn, a pivot point is selected and runs laid and rollers set to operate about this point (Fig. 3).

In the alteration of buildings such as the change in fronts or shoring of floors or the supporting of heavy structures where high blocking would be required, pump logs or drums are used. Pump logs are timbers, usually 8 x 8 in. in size, but often larger, one end of which is bored to a 4½-in. diameter about 18 ins. deep. In this hole operates the screw, the lower part of nut sets in the 4½-in. hole in the timber and the flange of nut bears directly on the bottom of timber—more often a collar block is used to form a bearing for the nut. Drums are usually set in position with the screw at the lower end, so that the screw may be more easily operated.

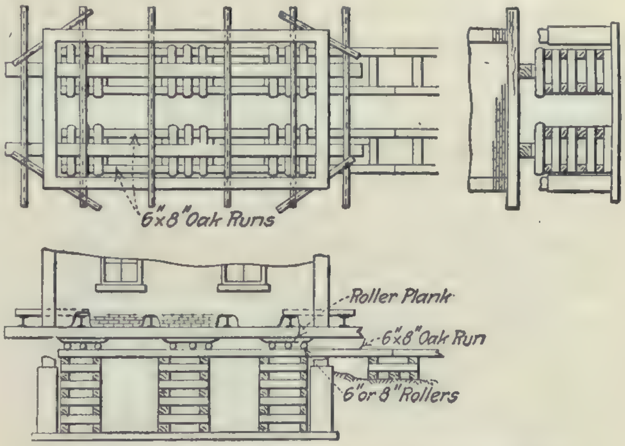

Fig. 2—Arrangement of runs and rollers for moving a building.

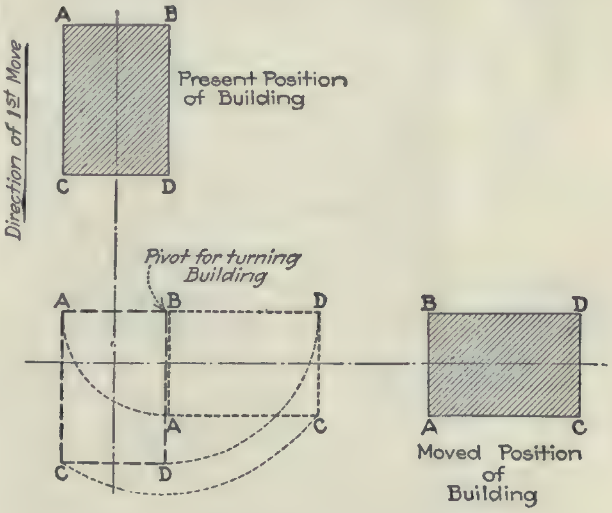
A
B
Present Position of Building
Direction of 1st Move
C
D
Pivot for turning Building
A
B
D
A
C
C
D
B
D
A
C
Moved Position of Building

Fig. 3—Plan for moving a building and making a quarter turn.

In the moving of brick structures great care is required to keep the building level and the movement uniform. It is usually customary to run cables entirely around the building and tighten by means of ratchets. In attaching the ropes to take the blocks for moving a brick structure, these are not connected directly to any part of the brick building, but to the timber or steel grillage upon which the building sets.

The building is watched carefully by all the men to assure raising in a level position. These levels are procured by means of ordinary carpenters' spirit levels, which are placed on runs and timbers which support the structures and these kept as near level as possible. In raising the building a number of screws are divided among the men. Each man may have ten screws to turn. Each man takes his screws and makes two rounds on a given signal. He starts at one end and makes a quarter turn and goes through to the end of his screws, and then returns and stops until every one else is through and until the signal to turn is given again.

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* From a paper by Geo. W. Nichols, published in the Proceedings of the Engineers' Society of Western Pennsylvania.

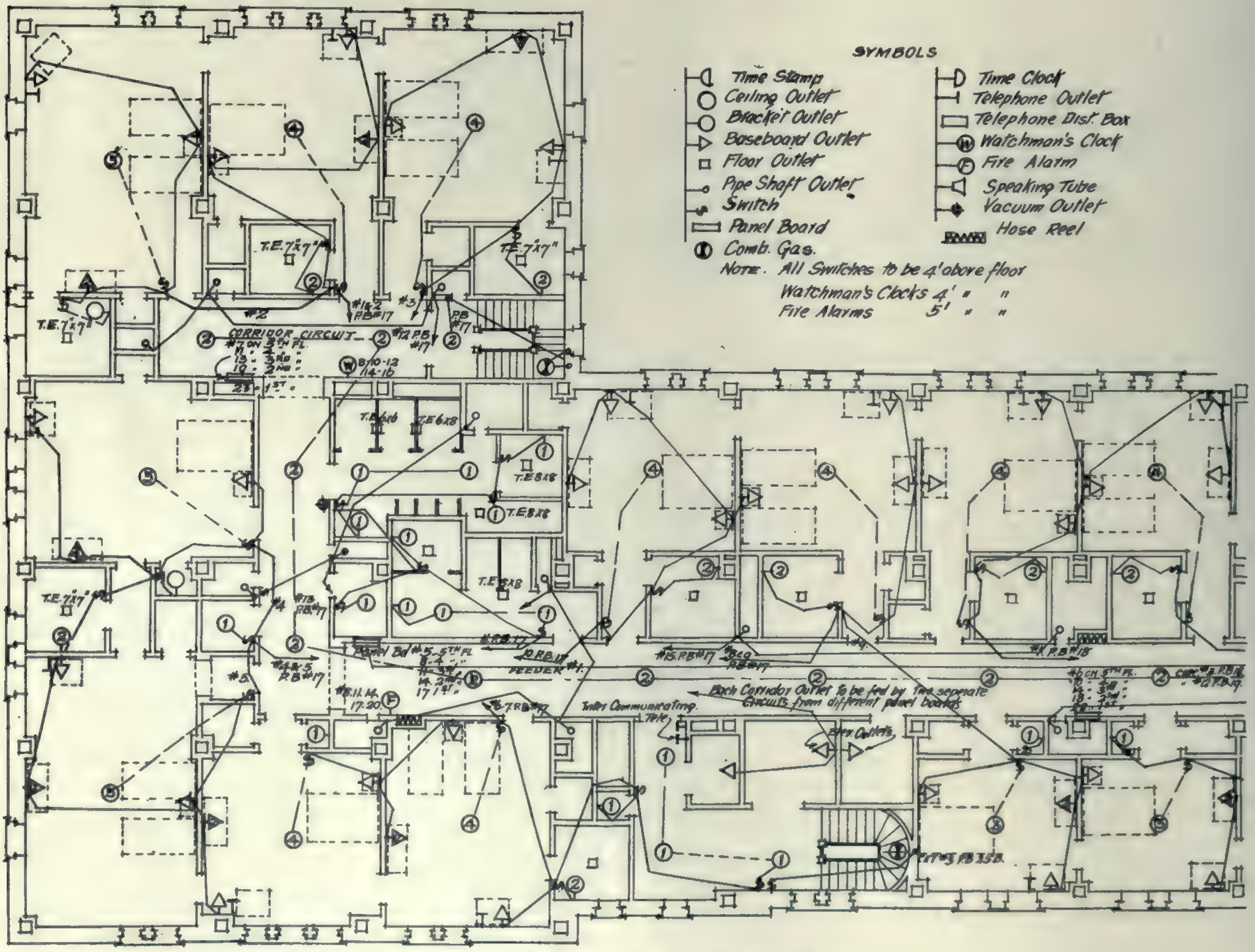
The Wiring of Large Public Buildings

NO class of building is receiving more attention at the present time as to the electrical installation than our large hotels. An excellent example of this is the Hotel Macdonald, Edmonton, one of the chain of fine hostelries the Grand Trunk Pacific Railway Company are installing across Canada. This hotel, in common with the Fort Garry at Winnipeg and the Chateau Laurier at Ottawa boasts as complete an electrical installation as can be found anywhere on the continent. The architects of the building, now nearing completion, are Messrs. Ross & Macdonald, Montreal; the general contractors are the Canadian Stewart Company, Montreal. The electrical equipment is being installed by the L. K. Comstock Company.

In accordance with the best practice no wall lights have been installed. These have long proved unsatisfactory both on account of the fact that they generally render a re-arrangement of the furniture impossible and also because they do not provide a general illumination. Prejudice in their favor, on account of their decorative effect, has died hard, however, and it is only within the last couple of years that the comparative uselessness of wall lights as a means of illuminating a room has been recognized.

The Hotel Macdonald is following the most approved practice and installing a centre ceiling outlet in each room with at least three baseboard outlets. This means one base outlet for a wiring desk, one for the dresser and one for a reading lamp beside each bed. These baseboard receptacles also facilitate the use of all sorts of modern electrical appliances such as curling tongs, electric irons, small electric heaters, etc., all of which add to the comfort and convenience of the guests. Further, each room is equipped with two circuits so that in case of trouble on one circuit the guest is not placed at the inconvenience of being without illumination. Each bedroom floor is supplied from three panel boards which lead direct from the main switchboard thereby insuring a portion of the general illumination in each floor under any emergency except an entire break-down of the generating plant in the basement and at the same time of the local municipal lighting system.

The laundry and culinary department are equipped with the latest modern electrically operated apparatus. Electric elevators are installed and a complete electrically-driven ventilating system. The laundry machinery is, of course, of the most recent design and the units are driven, wherever possible, by individual motors.



Part of a typical floor plan of Hotel Macdonald, Edmonton, Alta.

The lighting is supplied from a 110/220 volt, three-wire, direct-current system. Power is supplied at 250 volts direct-current.

The hotel is supplied with its own generating plant consisting of Goldie & McCulloch engines and Triumph Electric Company (Cincinnati) generators. In addition to the private plant the lines of the Edmonton municipal plant have been extended into the hotel as insurance against break-down in the private plant.

The wiring is in conduit throughout, the material being supplied by the Conduits Company, Limited.

In addition to the features already mentioned a number of floor outlets have been installed; also a time clock system, a telephone system, a fire alarm system, and a vacuum cleaning system. We reproduce herewith a portion of a typical floor plan. The portion reproduced represents perhaps one-quarter of one of the five floors.

Reporting on Public Service Properties

By E. P. Roberts*

THE engineer has many opportunities to benefit mankind; by research work, assisting younger engineers, and endeavoring to assist in advancement of all kinds—civic, industrial, sociological—along many of which lines his training makes him especially useful. The following paper deals only with his employment by Capital to obtain returns for Capital, and, therefore, values are financial values. The engineer is paid in cash to deliver in cash.

Employment of Engineer on Financial Basis

Engineers often complain that their compensation is not proportionate to their ability and responsibility. After-dinner speakers especially dwell on such points. But engineers are not unique in this respect. From ministers, lawyers, doctors, architects, bankers, manufacturers' associations, trade associations, and other groups, the same complaint is heard: "If it were not for us, where would be our civilization? We are the great benefactors of the human race; pay us what we consider is in accordance with the benefit we confer." In a general and broad way, everyone receives for his services in proportion to supply and demand. To such extent as the measure of compensation is financial, each person receives an amount of money based on what the buyer believes he must spend to obtain that which he desires. When Capital employs an engineer, it is on the basis of financial benefit to Capital, and the engineer accepts employment on such basis. If the engineer does not furnish to Capital the best advice obtainable he is as dishonest as if he does not make every effort to obtain full value from a contractor whose work he supervises. It is the engineer's duty to study each and every question, which either directly or indirectly affects such portion of the problem as is in the engineer's charge, and then to advise the representative of Capital to the best of his ability. If personally he is not able to advise competently, he should obtain such advice and pay for it, or inform his superior officer, or client, that certain questions, or certain phases of some one question, should receive greater attention and investigation than his knowledge or available time will permit. Many engineers have had no training in financial matters, but it is becoming more and more realized that the engineer should have a broad training, including a knowledge of the principles of economics, accountancy, and business law, and should be able to study engineering problems with relation to financial results. There has, possibly, been a feeling that information along financial lines was difficult to obtain, or so intricate, or unscientific in character, that the engineer could not expect, by the expenditure of such effort as practicable, to obtain any knowledge which would be helpful. The engineer appreciates the fact that he must obtain a broad and general engineering knowledge before specializing, and then must specialize before he can make exceptional progress in any line, and concludes that there is no time available in which to obtain knowledge along other lines, or there is no necessity for it, or both. Whatever the reason for such conclusions, it is erroneous and harmful to him and to the profession. If representatives of the legal and engineering professions in any one city are compared, it will be found that more lawyers than engineers are consulted on financial questions. Lawyers receive a broad general training, as do engineers, and then usually specialize. There are always a number of prominent lawyers who are directors in banks, and others are appointed receivers for bankrupt properties. Of course, such receivers are frequently appointed by their professional brethren—in other words, by judges. Frequently, if not usually, executive ability is more important than legal ability; in fact, frequently, legal questions do not represent ten per cent. of the problem. Without reference, however, to appointment by the Court (acquaintanceship or professional courtesy), probably the average business man would select a lawyer rather than an engineer for such a position, even when the business is a manufacturing or transportation one.

Engineers as Railroad Executives

That frequently engineers are good executives is evidenced by the growing tendency on the part of steam railroads to appoint executives from the engineering force. This is especially interesting in view of the increasing difficulties confronting railroad executives at the present time, as the result of regulation by the Interstate Commerce and Public Service Commissions. In other words, now that the business must be conducted on a basis, Wall-street methods, or those frequently considered as such, are no longer permissible.

Comprehensive Advice

I have already stated that the engineer should have one aim—namely, to obtain dividends for capital; but if he is only able to advise as to the technical design and construction cost, it is evident that his usefulness, and therefore the value of his advice, is exceedingly limited. He may be able properly to advise correctly as to the financial results as between two different classes of structure. An example of such simple character arises when considering the comparative advisability of building a trestle structure or a comparatively permanent bridge. He may be able to report as to the first cost, and proper allowance for maintenance and depreciation of each, and possibly correctly state that, for the case under consideration, the cheaper structure is the preferable one, if considered on the direct basis of cost per year, including interest, maintenance, and depreciation; or that from the standpoint of fire or floods, it may not be advisable. He may properly consider the funds available and financial demands at other points, and state that the erection of a permanent and expensive structure can wisely be left to the future. The above example is a comparatively simple one, though frequently such simple cases are not sufficiently investigated by the engineer. The engineer cannot expect to become an expert lawyer, accountant, economist, or financier; at least, most of us would not be so optimistic. He should, however, appreciate and understand the result of the investigation made by experts along such lines, and the application of such results to the work of the engineer.

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* From a paper read before the Engineers' Club of Philadelphia.

Co-operation

The engineer should also appreciate the fact that it is part of the duty of the engineer to inform other experts as to many facts which often they would not know existed unless he calls the same to their attention, and, in addition, there are many factors the full value and effect of which cannot be ascertained except by co-operative effort. Even in purely technical work the engineer must rely upon others. If he is in charge he should understand the general principles of the methods followed by his assistants, in order to appreciate the value of the result obtained by them, and to take full advantage of their abilities. For example, many of us are no longer able to work out problems in higher mathematics; but if we did not know what could be best accomplished by the application of same, or understand the meaning and comparative value of the answer submitted, we would not instruct someone to make the investigation or calculation; in fact, we might not have such a man in our employ, because we would not feel the need or appreciate his usefulness. To obtain the answer to a technical example is important: that is what we pay the assistant to do. To ascertain the value of the answer and place it in the proper place with relation to all the other factors of the main problem, is what our employer pays us to do.

Technical School Training

In the past few years more and more attention has been given in technical schools to instructing the students in the fundamental principles of accounting, business procedure, and business law. A leader in such work is Dr. A. C. Humphrey, now President of the Stevens Institute of Technology. He, by virtue of his business, in addition to technical training, realized the importance of starting the students along the lines above mentioned, in order that they might, to as great a degree as practicable, not only understand the general principles, but, of more importance, appreciate their bearings upon and relation to the technical work of the engineer. Lectures and examinations on such subjects have been for many years part of the regular work at Stevens. Recently a conference was held at Stevens upon "The Engineer's Part in the Regulation of Public Utilities." The conference was attended not only by alumni and guests, but also by the under graduates. It was addressed by a number of prominent corporation officials and by a member of a public service commission. It seems to me that many of those present, though especially the students, will become bigger men and more competent and fully-rounded-out engineers, because of the conference; not so much on account of the information conveyed, valuable as it was, but because of the inspiration resulting from hearing such subjects discussed under conditions especially tending to influence young men.

First.—What is a Public Service or Public Utility Property?

Second.—Why is it constructed?

Evidently the answer to the first question is that a public service property is one constructed to give service to the public. The service may be rendered by the community—municipal ownership—but such is not the ownership of the properties now to be considered, though the same general principles should be applied, including engineering, operation, and accountancy. A public service property is usually considered as one furnishing service to the public, but the ownership of which is private. The peculiar characteristic features are that the owners agree to give adequate service, and the public agrees to give the owners the opportunity to furnish the service. Certain privileges are granted, such as condemnation of properties for right of way, rights in the streets, etc. Frequently, not always, the public permits, or practically assures, a monopoly, either during "good behaviour" or for a specified period. The person who serves is a servant—at least, according to the dictionary; but in fact the duties of the servant are liable to be forgotten. The person served is the employer or "boss." Sometimes the latter term not only seems more personal, but also more applicable. Commissioner C. J. Prouty, of the Interstate Commerce Commission, in an address to the Cleveland Chamber of Commerce, stated: "Now, to go back to my proposition that the railroad is the servant of the public. Assume that you had an intelligent servant, who was especially skilled to do a particular thing, how would you, as a prudent master, treat that servant? You would certainly give him enough to live on, because he couldn't work until he could properly subsist." Mr. Prouty also stated, referring to the railroads, that the servant was at one time the master, and, if I correctly understand his statement, that there is now a tendency to starve the servant and to take away both incentive and ability to give adequate service.

Another way of considering the relationship is that of a special partnership agreement between the public and the public service corporation.

Franchise Period

Franchises may be short term, perpetual, or indeterminate. Short-term franchises have many defects, perpetual franchises frequently, possibly inherently, do not properly protect the public, or the owner, or both: they are either "wide open" or have unwise restrictions. Indeterminate franchises, sometimes termed indeterminate permits, are permits to control and operate during "good behaviour" on the part of the corporation legally supposed to be "enjoying" the operation, whatever may be the facts as to such enjoyment. It is also often presumed that the owner will be protected from competition because it is in the interest of the public that the utility be a "monopoly," and that if the owner exercises reasonable care in designing, constructing, and operating the utility, that he will be permitted to obtain and retail such form of enjoyment as results from dividends. To an increasing degree it is becoming a fact that public service commissions are not only protecting the public, but also are —or, at least, some are—protecting the owners and instructing the public as to not only what is fair treatment, but also what is in the permanent interest of the public.

In the issue of January, 1911, of the American

Academy of Political and Social Science (Electric Railway issue), the statement is made that the Wisconsin theory is that the franchise is a privilege conferred by the State, and not a contract between the municipality and the company, and that it is subject to State regulation when and as regulation is required. Massachusetts permits a certain "location," and other States have different angles of approach; but, I believe, that the general tendency is towards control and protection. Control, as to financial scheme and securities issued and as to service; protection, as to avoidance of all forms of special tax, for which the public, or, rather, the users, must pay or not obtain adequate service and protection from competition. An indeterminate franchise is somewhat similar to an indeterminate sentence, as it is also dependent upon "good behaviour." Both indeterminate franchises and indeterminate sentences have good features, though the particular recipient may not always appreciate the application.

The second question is, "Why is a public service property constructed?"

The answer might seem to be because of the public need. The correct answer is because someone thought it would pay him. It is the same reason which exists for putting forth any effort. The question always asked is, "Will it be profitable?" In a business transaction the profit is measured in money. There must be a promoter, and this promoter is a most helpful member of the community, though not always for it.

Why is an engineer employed to report on a public service property? Usually in order to inform his client as to whether the property has paid, or will pay, or both, on the investment. The engineer must, or should, be a skilled prophet.

The author then went on to consider the preparation of a report upon a proposed interurban electric railroad, touching briefly upon some special features of reports relative to existing properties and properties other than interurban railroads.

Mr. J. G. Koppel, Superintendent of Bridges at Sault Ste. Marie, Ont., describes in "Railway and Locomotive Engineering," a clever bridge repair, which may be found noteworthy in connection with other structures. A crack developed in the foundation of the bridge crossing the ship canal at Soo, Ontario, as shown, which amounted to fifteen-sixteenths of an inch. A ½-in. steel plate was made in three sections, and drilled to fit on the jack-shoe bolts, and one jack-shoe at a time was removed and the plate laid in place and the jack-shoe replaced. When both plates were secured in position, then the centre-plate was put in and the belts screwed down, and when all were in tension the masonry was drawn into its original position, while a mixture of cement was poured into the crack, which made a very good job, as the foundation is now apparently as good as could be desired, and safer than the original structure, as nothing short of an earthquake could move the steel plate that was added to the structure. Not only so, but it is evident at a glance that a new idea has been added to structures of this kind. Masonry under direct vertical pressure is always reliable, but under slightly horizontal pressure of an intermittent kind, such as is caused by the oscillation of a heavy locomotive and attached train rounding a curve, the tendency of the masonry to crack or dislocate is very great, and a reinforcing plate should be used.

Canada's Trade With Germany

In view of the fact that Canada is absolutely prohibited from trading with Germany, the following comparative returns are interesting:

Fiscal Years	Imports—(Merchandise) Total	Exports—(Merchandise) Total	Totals Imports and Exports
1894	$ 5,872,085	$2,046,052	$ 7,918,137
1895	4,983,369	626,976	5,610,345
1896	6,454,705	757,531	7,212,236
1897	5,785,546	1,045,432	6,830,978
1898	5,763,784	1,837,448	7,601,232
1899	7,381,149	2,219,569	9,602,068
1900	8,706,641	1,715,903	10,422,544
1901	6,677,959	2,141,552	8,820,816
1902	10,919,994	2,692,578	13,612,572
1903	12,127,867	2,097,699	14,225,566
1904	8,028,544	1,819,223	9,847,767
1905	6,642,095	1,146,654	7,788,793
1906	7,040,091	1,872,557	8,912,648
1907 (9 months) ...	5,483,207	1,066,605	6,549,812
1908	8,250,745	2,374,607	10,625,352
1909	6,001,406	1,476,552	7,478,006
1910	7,958,264	2,501,191	10,459,455
1911	10,087,199	2,663,017	12,750,216
1912	11,146,739	3,814,914	14,961,660
1913	14,473,833	3,402,394	17,876,227

IT is refreshing to learn from Mr. W. N. Ashplant, City Engineer of London, Ont., that the European war has not materially affected municipal projects in the Forest City. Work is proceeding as usual on various local improvements, and upwards of four hundred men are employed on the construction of storm and sanitary sewers, pavements and cement walks. It is the intention of the city, we are told, to continue constructional operations as long as weather permits. Of course it must not be taken that there is an abundance of work at London and that this city is a sure haven for all the unemployed, but conditions generally, so far as the local situation is concerned, are very satisfactory. The municipal programme now being carried out comprises sanitary sewers, cement, brick, asphalt and reinforced concrete pavements, and the various storm sewer contracts undertaken early in the season.

A new method of destroying teredos, a pest which has caused enormous damage in the destruction of piles used in wharfage construction in north Pacific coast ports, particularly in Vancouver, Seattle and Tacoma, by turning an electric current into the piles, is being tried in Seattle. These pests have so far successfully defied all attempts to eradicate them from the timbers supporting the various structures along the water front in the Puget Sound and British Columbia ports, and a means of destroying them will prove a great saving to individuals and companies maintaining docks and wharfage properties on the coast.

An increasing share of the rapidly growing consumption of cement in the United States is being supplied by the domestic industry, production having risen from 8,000,000 barrels in 1890 to 93,000,000 in 1913; while imports of cement have fallen from 2,350,000 barrels in 1890 to 95,827 barrels in the fiscal year 1914, with one exception the lowest total reported in many years.

The Cost of Doing Business, as a Factor in Contract Work

By Edwin L. Seabrook

WHAT does it cost to do business? This is a vital question to every one engaged in a competitive line, such as building construction. Vital as it always has been and is, it is understood by some, applied by a few, misunderstood and misapplied by many and unheeded by many more. It is vital because upon its proper application depends the profits to be derived from the business.

Every price asked for a piece of work is or should be composed of four items: cost of material; cost of labor; expense of conducting the business; profit.

It is impossible to perform any contract, however small, without the first three of the above items entering into the price asked. It is possible and many do get along without the last item—profit. This is not intentional, but because the third item—expense—is not properly understood and applied. If the item of expense is not known how is it possible to intelligently estimate and compile a price for doing work? Many wonder at the end of the year where the profits are they believed were being made during the twelve previous months.

The difference between forty cents an hour paid to a mechanic and the sixty cents received for that hour's time on jobbing looks like a big margin of profit and many are deceived by it because the expense of carrying on the business one hour is not accurately understood. When the microscope of cost analysis is put on this twenty cents very little of it will show as profit.

During the hour the mechanic worked a very large percentage of this twenty cents was sent out in many directions for many items of expense; when the expense for the hour is taken out very little is left of it. No doubt many will look askance at the statement that, unless the employer charges fifty per cent. more per hour than is paid mechanics when hiring them to some one else by the hour, he is hardly breaking even. This is a fact, nevertheless, in some lines of building work and can be clearly demonstrated. Whether the fifty per cent. is too little or too much in some lines of building work, the principle will maintain.

The cost of conducting business is more often underestimated than over-rated. Many are willing to delude themselves with the plea that they are not under as much expense as some other competitor; in only exceptional cases is this true. One man thinks because he works himself, does his bookkeeping (what is done) at home nights, he cannot possibly have as much expense as the competitor doing no mechanical work himself and employing office help. This theory may be correct, but it cannot be worked out in practice. No employer can himself do mechanical work all the time, and unless he does, this beautiful calculation is upset; at least one-third of his time will be spent in looking after work, collecting and many other things of like nature. His expense goes on while he is attending to these duties, but he is not producing anything to meet it.

An analysis will show that the cost of conducting business is just about the same for each one in any particular place in the same line of business. One may have an advantage over some one else, but this is nearly always offset by some disadvantage generally overlooked in making the comparison. Cheap rent for one may be offset by undesirable location, increased expense in handling work, holding trade, or securing a proper share of the natural increase in business. Personal interviews with hundreds of firms in one line of the building business on this very question of a level expense rate of conducting business in the same city confirms the statement that no one firm has any advantage over another.

Some of the items that enter into the cost of doing business are: rent; interest on investment; light and heat; insurance: fire and liability; taxes, depreciation of tools, plant, etc.; horse and wagon; office help; advertising; telephone; printing; postage; bad accounts; salary of proprietor.

Every one of these items must come out of the price received for work. If these items are not put into the price in the form of expense it is not possible to get them out unless the fourth item—profit—composing the price is robbed. The cost of the above goes on Sundays, holidays, nights, rainy days, through dull times; it stares one in the face three hundred and sixty-five days in the year. Any one keeping an account of cash expended can readily ascertain the amount of the different items entering into the cost of doing business. Many do not do this and their case is hopeless; others do not keep an accurate cash account and thus pay out sums for expense which are never included in any attempt to ascertain the cost; others are not over particular to include every item. One person told the writer when he named many small items not included in his schedule of expense: "Don't get the thing down too fine." Too many are afraid of this measuring rod. One important item is often overlooked; that is, interest on the amount of money invested. This item should come in the expense account, because if the money was not invested in the business it could be loaned and bring a fair return. The same principle will apply to buildings owned by the proprietor who thinks a proper rental should not be included in the expense account.

Disbursements of money in any form of contract business can generally be classified under three heads. Material, productive labor, and expense. By productive labor is meant mechanics who actually produce something for which a price can be charged. A driver or a clerk would not come under the head of "Productive Labor." Any payment of money, therefore, that cannot be charged to productive labor or material is and must be a part of the expense of doing business. This simple classification of expenditures may assist many who wish to ascertain what it is costing them to do business.

Assuming that a fairly accurate schedule of expense has been made, what about the application? This is more important than may seem at the first glance.

There are two methods, both of which have been widely discussed within the last three years. One is to add the cost of labor and material for the previous year and find the percentage of expense on this total, The other is to make the productive pay roll, or, in other words, time, bear the entire burden of expense. The first named method seems to be (although mistakenly) the easiest understood and applied and is the most frequently used. Like many other easy things it is often misleading and subject to fluctuation. It often allows the user to ease his conscience when in a tight place by not insisting upon it being applied in full. Those who honestly use this method are on much safer ground than those who make a guess at the expense and get about half enough. The second method is somewhat newer, not quite so well understood, but is just as easy of application as the first, and is much safer because it lays a plumb line on every item of work done, is more accurate, more uniform and does not allow loopholes through which to crawl by knocking off part of the percentage which should be added to high priced materials with the plea that the job will not stand it.

Application of Cost

Shall the expense of conducting business be applied by the percentage method on the cost of labor and material combined or on productive labor alone? This is important because it does affect very materially the price named in some cases. The latter method makes the time it takes to do the work bear the entire expense. There is a vast difference between material and time regarding expense. The only expense incurred by material is the interest on the money invested in it. Expense is measured by time and goes on every day in the year, whether holiday, weather conditions permit of working, or in lost time, etc. Rent and a hundred other items are not measured by the cost of material, but by time. The whole expense is so much for a year, a month, a day, down to so much an hour. A man renting space in a garage pays for the time occupied regardless of the cost of the machine. Time measures the expense of doing business and this should be applied on the time it takes to produce the given piece of work regardless of the cost of material. Ten pounds of iron may be worked into an article in an hour; but it may take three hours to make another ten pounds of iron into something else. The latter should bear three times as much expense as the first. Ten pounds of copper may be worked up by the tinner in the same time as ten pounds of iron; while one costs six times as much as the other the same amount of expense should be applied to each. Simply because the copper as material cost more than the iron, in the working it did not consume any more rent and other expense. It is therefore most unjust to make it bear several times more expense than the iron, which would be the case if applied on a percentage basis of material and labor.

One simple illustration will show how easy it is to disregard the cost of doing business and almost toss it aside entirely when it is applied on the cost of labor and material. Let us assume a bid is asked on some work and the estimator allows twenty per cent. of the cost of labor and material for expense. The material costs $100; labor, $25, or $125; 20 per cent. for expense is $25, making a total of $150, upon which can be added the desired profit.

Suppose the one for whom the work is to be done wishes the material changed to a much more expensive one; something that will cost, say, six times as much. It will take a little more labor for this expensive material, but for the illustration let it remain the same. The estimate then would be: Material, $600; labor, $25, or $625; 20 per cent. for expense, $125. Total, $750. Note that the expense item has jumped from $25 to $125 by simply changing the material. Does any one pretend to say that the "expense" of doing this work increased $100 simply because of the increased cost of the material? How many would say: "If I add that amount for expense I will get the work." If the amount is not added there is a certain loss because the percentage of expense is based partly on the price of material. The expense calculation at the beginning of the year showed that 20 per cent. must be added to the cost of labor and material in order to meet this item. If $50 or $75 of this particular $100 is disregarded who can say that this is not a loss? True, the loss may not be realized, but the expense must come from somewhere. If a sufficient amount is not in that column it must come from the profit column. If the expense item had been placed entirely upon the time it took to perform the work the price for the more expensive material would have been more reasonable.

Perhaps the wide difference in some estimates is not due so much, as is often intimated, to ignorance or error, as the proper application of the expense item.

How shall the expense be applied to time alone? It is the simplest of all methods. Take the wages paid mechanics or productive pay roll; take every item of expense and compare the two; get the percentage of expense to pay roll; if the pay roll to mechanics that produce is $5,000 a year and the expense is $2.500 then the expense is 50 per cent. of the productive pay roll. When a dollar is spent in wages, fifty cents has gone in many directions for expense. Let no one deceive himself about 50 per cent. being too high a percentage for many lines of building work. Experience from more than nine-tenths of the tests made by comparing a pay roll book and the expense account shows that it is around 50 per cent., varying but little one way or the other. If this be a fact can the employer pay a mechanic forty cents an hour, hire him to some one else for fifty-five cents and make a profit?—National Builder.

At Hamilton, Ont., the principal work now under way is the West End sewage disposal plant, which will be completed during the next five or six weeks at a cost of $70,000. The main pumping station at the Beach will be finished in a couple of months. These works, with the asphalt paving construction, will maintain the activities of the Engineering Department for the remainder of the season. It is intended to ask the provincial government for authority to proceed with the installation of a trunk sewerage system in the eastern portion of the city at an estimated cost of $110,000.

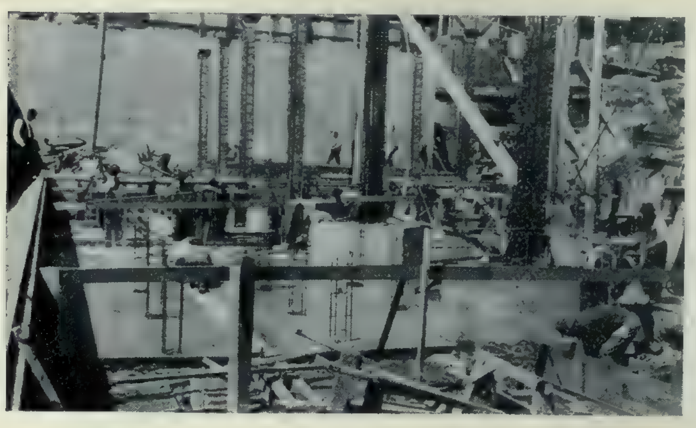
The Nova Scotia Steel & Coal Company is reported to have received a large contract for shells for the Canadian artillery. Contracts for the production of shells are said to have been placed with all the steel plants possessing the necessary equipment for turning them out.

Manufacturers in the electrical trade on the other side of the border claim that the removal of Germany from the field, even temporarily, will result in diverting to the United States electrical orders worth $100,000,000.

Constructional Features of a Double-Deck Car Barn at Vancouver

Work is already well advanced on the construction of a car barn for the B. C. Electric Railway Company, Limited, at Vancouver, B.C., the estimated cost of the structure being $350,000.

Some years ago the company purchased an entire city block in the Mount Pleasant district with the idea of utilizing the block for car barn purposes. The block has a frontage on Main Street, one of the principal car line streets in the district, and extends to Quebec Street, the other boundary streets being Thirteenth Avenue and Fourteenth Avenue. On the north half of the block the company several years ago erected two car barns of the galvanized iron type of construction, capable of accommodating 60 cars. The new barn now in course of construction is located on the south end of this block and adjoins the old structure. The new barn will be two storeys in height on Main Street and one-storey in height on Quebec Street, the difference in grade between the two streets being such as makes this plan possible. The dimensions are about 350 feet by 130 feet, the height of each storey being approximately 20 feet. On the ground floor the entire area will be available for the housing of cars, the ten trucks making provision for 62 cars. The Quebec Street frontage of the second storey is placed 45 feet back from the street line, thus giving a floor area of 302 by 130 feet, sufficient for the accommodation of 58 cars. This will make the total capacity of the new barn 120 cars and the total capacity of the company's barns on the block, 180 cars.



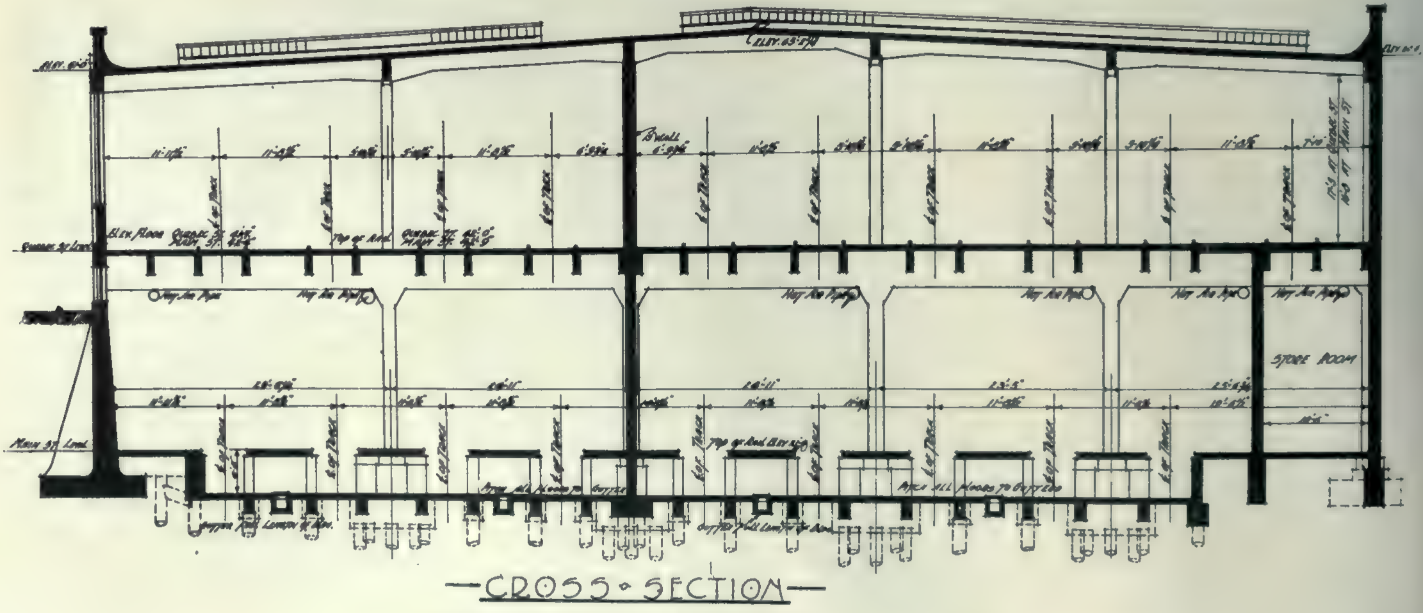
Interior new B.C.E.R. car barn.

The block is naturally low lying and after investigation of the soil the engineers decided that a pile foundation was advisable for the new barn. The average length of the piles driven is 20 feet and the building is so designed that the entire load is carried on the piles, no allowance being made for any load being carried on the soil.

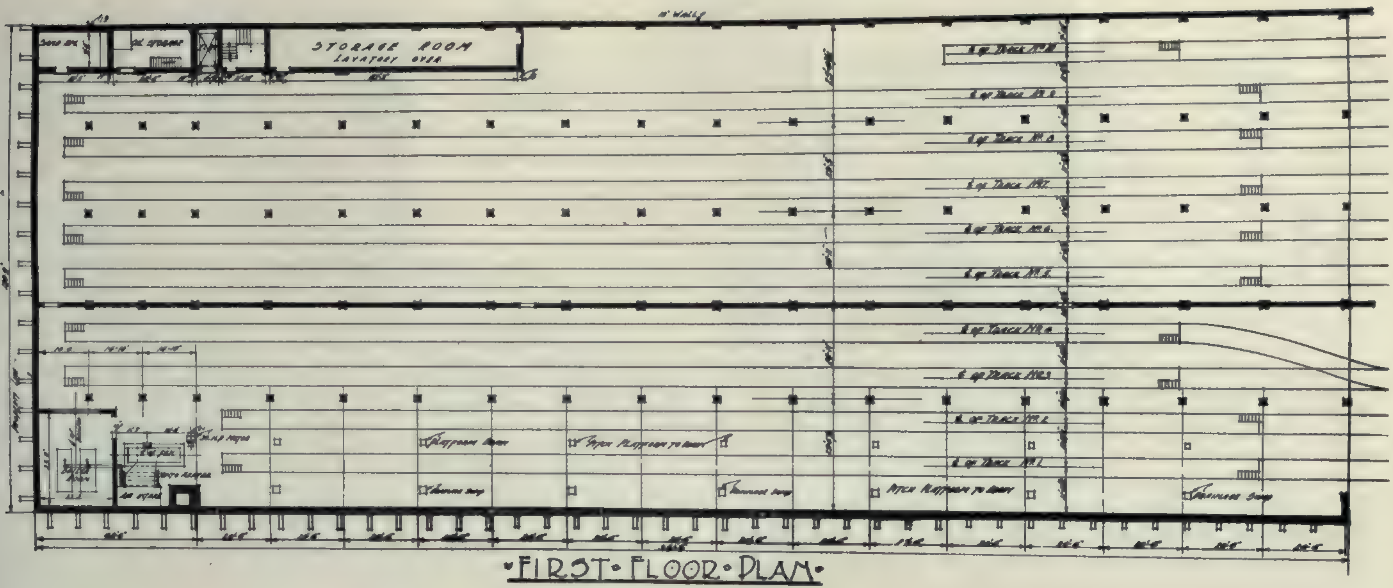
The general type of construction throughout the entire building is reinforced concrete skeleton with the exception of the columns between the first and second floors, where steel is used in order to economize floor space.

The building will be finished with 13-inch brick walls on the outside. In these walls will be fixed steel sash glazed with quarter-inch wired glass and steel doors of the rolling type which are to be chain operated. Practically all the tracks on the first floor will be provided with pits for inspection purposes. The floor consists of five-inch reinforced concrete slabs between the rails, these being supported on 12-inch square concrete piers, placed at about seven feet centres, extending from the pit floor. The pit floor is 4½ feet below the level of the barn floor and is formed of six-inch concrete with piles under each of the track pedestals and building columns. The floor is graded to drain into four channels 10 inches wide which run the whole length of the building and are covered with iron gratings.

The second floor will be used merely for storage purposes, no provision being made for inspection pits, etc. Five-inch reinforced concrete slab construction is used with reinforced concrete girders 8 by 24 ins. placed under the rails. The second storey is supported on concrete covered steel columns placed between each pair of tracks, the centres varying from 23 feet 5 inches to 29 feet 6¼ inches and the lengthwise spacing being about 20 feet 4 inches. The cross girders be-



Cross section B.C.E.R. Company's new car barn, Vancouver, B.C.



First floor plan B. C. E. R. Company's new car barn, Vancouver, B.C.

tween the columns are 3 feet 10 inches in depth. The roof of the building will be 3½-inch reinforced concrete slab carried on cross concrete beams 18 inches in depth.

For the construction of the building it was necessary to excavate about 12,000 cubic feet of earth. The approximate amount of concrete used is 5,500 yards and the construction plans call for the use of about 400 tons of steel.

The building will be heated by an indirect heating system, oil fuel being used. This installation consists of two 70 h.p. boilers, the heating being driven through ducts running through the building, by a 130-inch fan. For the rooms set apart for the use of barn employees and street car men a direct steam heating system will be employed.

In accordance with the requirements of the fire underwriters a steel tower carrying a water tank with a capacity of 35,000 gallons will be installed above the second storey. This is connected with a sprinkler system which provides 2,450 heads throughout the building, both roof and aisle sprinklers being installed. Both floors are divided into two sections by a thirteen-inch brick fire wall.

One track on each floor will be arranged for the washing and painting of cars. On the lower floor provision is made for a room for sand drying and the storage of oil. On this floor is also located a shop for carrying out minor repair jobs, a freight elevator 5 by 8 feet in size connecting the shop with the second floor.

The cars will enter the first floor of the barn direct from Main Street. For the purpose of affording entrance to the second floor the company will construct a track from Main Street along Thirteenth Avenue and Quebec Street to the second storey entrance. The plans of the company provide for the continuation of the facade of the new barn along the entire Quebec Street frontage of the block.

It is expected that a portion of the accommodation afforded by the barns will be available by October 1st.

The new barn is designed to accommodate the cars of the company operating in the eastern section of Vancouver as well as its South Vancouver lines. For the accommodation of its cars operating in the western section of the city the company last year constructed a large car barn in the Kitsilano district.

Operations are progressing satisfactorily on the erection of the Ernscliffe Apartments, at Toronto. The estimated cost of the new building is $500,000. The construction is steel, stucco and brick, and the building will be eight storeys high. Messrs. Deeth & Son are the owners and general contractors, and Mr. N. G. Beggs, Toronto, is the architect.

From Winnipeg comes the announcement by Hon. Dr. Montague, Minister of Public Works, that work on the Provincial Parliament Buildings will be undertaken immediately. Constructional operations on the new law courts at Winnipeg are to be continued as long as weather permits.

A plan for the water-works system for West Vancouver, submitted by Mr. H. L. McPherson, has received the approval of the Municipal Council, and in all probability a bylaw will be submitted to the ratepayers. The estimated outlay is $150,000.

The C. P. R. Pitt River bridge in British Columbia, which has been built at a cost of $1,000,000, is nearing completion. The contractors for the sub-structure were the Foundation Company, and for the superstructure the Dominion Bridge Company. The sub-structural work was described at length in the Contract Record of September 30.

At a meeting of the directors of the Dominion Steel Corporation the President, Mr. J. H. Plummer, expressed regret that the demand had fallen off just when the plant had attained its high point of efficiency, both as regards production and quantity. He said, however, that the Company were not losing any time in getting after new business. The war had diverted quite a number of contracts to the plant. England had already placed orders for 2,000 tons of rails and 2,000 tons of wire rods, and negotiations were pending in another direction for a large order of rails.

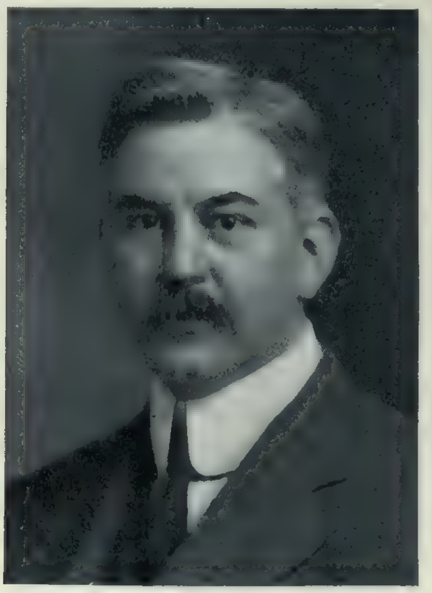
It is announced that work on the harbor development at Toronto, will be continued in accordance with the plans laid out at the beginning of the season, despite the conditions in Europe. The Harbor Commission, of which Mr. Alex. C. Lewis is secretary, will expend approximately $1,400,000 this year on reclamation work, pile driving, piers and the excavation of the ship canal in Ashbridge's Bay. About 1,000 men are now employed, half of them being in the service of contractors, and the remainder in the employ of the Harbor Board.

Personal Mention

Dr. W. A. Parks, Director Royal Ontario Museum of Palaeontology

MANY readers of the Contract Record and Engineering Review will be familiar with the Report on the Building and Ornamental Stones of Canada issued recently by the Department of Mines of the Dominion Government. The author of this valuable work is Dr. W. A. Parks, Director of the Royal Ontario Museum of Palaeontology, and Associate Professor of Geology, University of Toronto.

William Arthur Parks was born at Hamilton in 1868 and entered the University of Toronto at the age of twenty. Four years later he graduated with first-class honors and was awarded the Cawthorne Medal in Natural Sciences. Upon leaving the University he accepted a post as chemist with the Canadian Copper Company, of Sudbury, Ont., and Cleveland, Ohio. In the following year he was appointed Fellow in Geology at the University of Toronto. During the summers of 1897-8-9 he was employed as a geologist by the Bureau of Mines of the Province of Ontario and prepared a number of valuable reports. Dr. Parks has the distinction of having been virtually the discoverer of the Porcupine gold fields. In 1900 the University of Toronto conferred upon him the degree of Doctor of Philosophy, his thesis for the degree being "The Huronian of the Moose River Valley."



Dr. Parks.

In 1898 Dr. Parks was appointed Lecturer in Geology at the University of Toronto, and in 1904 he became Associate Professor of Geology. From 1900 to 1905, during the summer seasons, he carried on important geological investigations for the Dominion Government. The work for which he is best known, perhaps, was undertaken by him in 1910 and has been continued to date. We refer to his Monograph on the Building and Ornamental Stones of Canada. So far, in this connection, the investigations have covered New Brunswick, Nova Scotia, Prince Edward Island, Quebec, Ontario and Manitoba.

Dr. Parks was appointed Director of the Royal Ontario Museum of Palaeontology only last year. He is essentially the man for the work, having had exceptional opportunities of becoming an all-round geologist. Up to 1904 his work lay chiefly in mineralogy and in Pre-Cambrian and Economic Geology. Since that time, in accordance with the wish of the University authorities, he has devoted his time more particularly to palaeontology, stratigraphical and economic geology. In addition to numerous official reports, a number of papers on scientific subjects, notably a series of researches on the Stromatoporoids of America, are the results of his investigations.

Reverting to Dr. Parks' report on Canada's Building and Ornamental Stones, it is of interest to recall that he was engaged for this work by the Mines Branch in April, 1910, when it was planned to devote a large volume of the series to a particular province or group of provinces. The results of the first summer's field work in Ontario are embodied in the Mines Branch report No. 100, entitled, "The Building and Ornamental Stones of Canada, Vol. 1." The first part of this volume contains general information with regard to the quarrying, testing and handling of stone. Part 2 is devoted to a systematic description of the various building and ornamental stones in that part of Ontario which lies south of the Ottawa and French rivers. The usefulness and high standard of this monograph are attested by the fact that there have been nearly four thousand requests for copies of it since October, 1912, when it was issued, as well as by scores of complimentary letters from the highest authorities and from men prominent in the quarry industry in Canada and the United States.

Early in 1911 Dr. Parks agreed to prepare a second volume on the Building and Ornamental Stones of the Maritime Provinces. The summer of 1911 was spent in field work and sixty quarries were visited. An edition of four thousand copies has recently been published as Report No. 203 of the Mines Branch. The third portion of the work is still in the press, although a brief synopsis of it is contained in the Mines Branch Summary Report for 1912. It will consist of an exhaustive description of the limestones, sandstones, granite, marble, slate, and other building and decorative materials of the Province of Quebec. This last summer the field work has been completed on the stones of Manitoba, preparatory to the publication of Vol. IV., which will include Manitoba, Saskatchewan and Alberta.

As evidence of the esteem in which Dr. Parks is held, it may be in order, perhaps, to publish statements made for the Contract Record and Engineering Review by President Falconer, of the University of Toronto, and Sir Edmund Walker:

> President Falconer.—"By his ability and constant work Dr. Parks has earned an enviable reputation in palaeontology, and as he is still a young man he should have many years before him in which to add greatly to the good results that he has already accomplished. Recently his work on the building stones of Canada has attracted considerable attention. We regard him as a Canadian scientist of high promise."
>
> Sir Edmund Walker.—"The fact that Dr. Parks is the Director of the Royal Ontario Museum of Palaeontology is evidence of the opinion held of him as to his acquirements in palaeontology and stratigraphy. On the latter subject he is one of the best informed men in Canada, especially regarding the economic side of his subject in connection with our building stones. He has an enormous capacity for hard work and his papers on palaeontology already rank among the best productions of their kind."

Like most other men of achievement, Dr. Parks is a very modest man and the statements of President Falconer and Sir Edmund Walker were obtained by us in the ordinary round of journalistic enterprise.

In closing, it may be added that Dr. Parks is a Fellow of the Geological Society of America and a member of the Canadian Mining Institute. As a member of the Executive

Council of the 12th International Geological Congress, he has prepared a number of valuable guide books.

W. Chase Thomson has been elected to membership in the American Society of Civil Engineers.

Mr. E. J. Smith (Lumsden Building, Toronto) has been appointed Clerk of Works on the new Registry Office now under construction at Toronto. The appointment was made by the Board of Control on the recommendation of the Property Commissioner. The salary is $150 a month.

Mr. D. E. Lloyd Davies has been appointed City Engineer of Cape Town at a salary of £2,000 per annum. Mr. Davies, who resigns the City Engineership of Alexandria to take the new position, was formerly Assistant City Engineer of Birmingham, Eng. He has a world-wide reputation as a consulting engineer, particularly in regard to drainage and sewage disposal schemes.

Mr. E. L. Horwood, of Ottawa, has been appointed Chief Architect of the Department of Public Works and has already assumed his new duties. The appointment is made to fill the vacancy caused by the retirement of Mr. David Ewart, who now becomes consulting architect, after filling the major office for some forty years. The post is an important one, since it embraces the responsibility for the design and supervision of practically all Government buildings.

The Cedars Rapids Power Development

The structural portion of the Cedars Rapids Manufacturing and Power Company's plant at Cedars, P.Q., is nearly completed. The fourth progress report, just issued, states that at the end of August 97 per cent. of earth excavation other than stripping and trench work, and 90 per cent. of the rock excavation was done. The earth excavation in trenches and ditches and stripping seats of the bank is completed, while 94 per cent. of the rock excavation was transported and placed. Of the stone protection 50 per cent. was done, and 97 per cent. of the transporting and placing of excavated earth was finished. The power house building is complete, and work has been started on the wing dam at the north end. Three generators have been installed and are ready for operation. All the material in the tail-race has been removed, enabling the tail-race cofferdam to be dismantled.

The transformer house, sixty per cent. of which is completed, is constructed by the unit method, with the exception of the columns, which were cast in place. Practically all of the slabs which go to make up this building have been cast, and the work of assembling them is progressing rapidly. The transformer house will contain the machinery for stepping up the voltage of current for transmission to Montreal and to Messina, N.Y. The general contractors are Fraser, Brace and Company.

The contract for the proposed shipbuilding plant and dry dock, which is to be erected at North Vancouver, has been signed at Ottawa on behalf of his firm by Mr. H. Spratt, Managing Director of the Amalgamated Engineering Company, Victoria, B.C. Arrangements for the project were completed in London before the war broke out, so that there appears to be nothing to prevent the construction of the plant in the near future. The estimated expenditure is $5,500,000.

The E. Laurie Company, Montreal, have been awarded, by the Council of Montreal West, P.Q., a contract for the supply and installation of an incinerator, of a capacity of 15 tons per 24 hours. The incinerator is of the Decarie type, and will be manufactured in Minneapolis, Minn.

Mainly Constructional

East and West—From Coast to Coast

A new incorporation at Toronto is that of the Toronto and Canadian Building Company. The firm will carry on a joint building and supply business.

At Hamilton, Ont., the excavation for a $1,000,000 soap factory which is to be erected by Messrs. Proctor & Gamble, Cincinnati, Ohio, is to be put in hand at once.

The city of Peterborough has received assurance from the Minister of Public Works that there will be little delay in getting the proposed new public building under construction.

The new St. Charles Hotel, at the corner of Bay and Richmond streets, Toronto, is nearing completion. The owner is Mr. J. J. O'Neil, and the architect, Mr. J. P. Hynes, of Toronto.

The City of Halifax, N.S., has just placed in service a 3½ million-gallon concrete reservoir. This reservoir will equalize the pressure and maintain the supply at the highest point in the high service district.

The exterior work on the new technical high school, now being erected at Toronto at a cost of $2,000,000, is well advanced. The architects are Messrs. Ross & Macdonald, and the general contractors Messrs. Norcross Brothers.

Nanaimo, B.C., has the matter of a Carnegie library under consideration and in all probability a by-law will be submitted to the ratepayers shortly. The Carnegie Corporation of New York have offered $50,000 towards the building.

On October 19 the ratepayers of Uxbridge, Ont., will vote on a by-law to raise $200,000 for electric railway construction. The project is a joint undertaking of the Provincial Hydro-Electric Commission and the Municipality of Uxbridge.

The new armoury whish the Dominion Government is erecting at Winnipeg at a cost of $520,000, has reached the roofing stage. The building is of steel and stone construction and is being erected by Messrs. Carter-Halls-Aldinger Company, Winnipeg.

Good progress is being made on the seven-storey reinforced concrete warehouse under erection at Toronto for Messrs| G. R. Gregg & Company. The architects are Messrs. Prack & Perrine, and the general contractors Messrs. Alexander Shunway & Utz Company.

At Edmonton, new stores and offices will be erected by Mr. J. N. Pomerleau, at a cost of $125,000. Plans are being prepared by Messrs. Hardie & Markland, Edmonton, for a four-storey building, 50 ft. by 150 ft. in dimensions, of reinforced concrete, brick and steel construction.

The Dominion Government's large elevator at Saskatoon has been completed and will be ready for operation on October 15. The building has eighty-four tubular concrete bins and is the largest single unit elevator in the world. There is accommodation for 3,000,000 bushels of grain.

The exterior work on the apartment house which Messrs. A. L. & J. A. Caron are erecting at Durochers Street, Montreal, at a cost of $108,000 is nearing completion. The new building is eight storeys high, 100 ft. by 50 ft. in dimensions, of brick and stone construction. The architects are Messrs. Gauthier & Daoust, Montreal, and the general contractor is Mr. G. Meloche, Montreal.

The City Council of Hamilton is contemplating the erection of a bridge 750 feet long at Burlington Heights. This structure is identified with the Toronto-Hamilton concrete roadway project. The estimated cost of the bridge is $200,000. Mr. A. F. Macallum is City Engineer of Hamilton.

At Notre Dame de Grace (Montreal), foundation work is in progress on the new Catholic Orphanage, which is being erected at a cost of $175,000. The architect is Mr. A. Piche, of Montreal, and the general contractors are Messrs. C. E. Deakin & Company, Limited, Montreal. The building is to be of stone and brick construction.

The Administration Board of the Greater Winnipeg water district has awarded contracts on construction amounting to over $6,000,000. The successful tenderers are all Winnipeg firms. Messrs. James H. Tremblay's award is for $945,945; Thomas Kelly & Sons, $1,301,485; and the Northern Construction Company, allied with Carter, Halls & Aldinger, for $3,895,210.

The widening of the Lachine Canal above the Cote St. Paul lock has been finished and as a result of the season's work of the Government contractors the curve which formerly made that part of the waterway difficult to navigate has been removed, portions of the canal now having more the appearance of a basin. The work has been carried out under the supervision of Lieut-Colonel H. R. Lordly, the Government engineer. In March last the work of remaking a portion of the canal was commenced, and the intervening seven months have seen a very considerable change. Although operations will not be discontinued entirely for another six weeks there only remain unfinished portions of the concrete wall of the canal which will form a wharf. Another part of the work, the power house building at Cote St. Paul, has to be completed, but this will not be done until next year. The cost of the eight months' work will amount to about $400,000. At times there have been as many as a thousand men employed on the contracts, and by the end of the season there will have been excavated more than 100,000 cubic yards of earth.

Building Materials Now Made of Rock

The marked increase in disastrous fires is directing more attention every day to the need of fireproof building materials that can be relied upon. The failure of many so-called fireproof materials when subjected to the intense heat of large conflagrations suggests the need of more careful judgment in the choice of these materials, as well as a more stringent interpretation of fireproof building regulations.

The demand for building materials that would not be affected by fire has encouraged manufacturers to experiment with all kinds of materials, but the only one that has thus far successfully withstood all tests is a peculiar rock known as Asbestos.

Asbestos runs in veins usually nearly parallel to the ground, in various thicknesses from a mere line to three or four inches thick. Some of these veins, however, reach a depth of 200 feet. In mining this rock, after removing the surface of the earth, the rock is drilled and blasted the same as granite or any other stone.

Deposits of asbestos, in one or more of its allied species, are found to a limited extent in Russia, Italy, Egypt, India, South Africa and, in fact, in all parts of the world. But that which is mined in Canada is about all that is of much commercial value, as other varieties are either too brittle to utilize or too hard to mine. By far the largest of these Canadian mines is owned by the H. W. Johns-Manville Company, of New York.

This asbestos rock, when properly worked, produces long silk fibres, which are manufactured into fireproof goods of various kinds, the most familiar of which, no doubt, is the asbestos theatre curtain.

These asbestos, or rock fibres, are made into felt, much along the line that the felt for hats is manufactured. This felt is then saturated with Trinidad Lake Asphalt, after which several of these sheets are cemented together with this material and thus made into ready roofings.

For shingles, these rock fibres are mixed with Portland cement and other ingredients, put into moulds of various sizes, and subjected to intense hydraulic pressure. The various colors are mixed with these ingredients, producing shingles of a number of handsome shades. Asbestos wood or lumber is also made in much the same manner as the shingles. Another use that is made of this material is in stucco, also wall plaster. Here the asbestos fibres take the place of hair ordinarily used and the asbestos rock takes the place of sand.

Another material which is fast gaining favor, chiefly because of its fire-retarding qualities, is Mastic, for floors.

The importance of fireproof construction can not be over estimated, and that architects and builders are fast realizing this is shown by the increase in the substitution of fireproof building materials for those of an inflammable nature.

Tubular Steel Tripod

Several novel features introduced into the construction of the Morris Folding Tubular Steel Tripod are described in bulletin Y17, of which a copy has been submitted to us by the Herbert Morris Crane & Hoist Company, Limited. One feature which will appeal to contractors, structural engineers, stone workers and other users of this kind of lifting gear is the ability to fold up the tripod without removing any bolts or pins. A broad flange is provided on each foot to enable the tripod to carry a load on soft ground, and a square point gives a good "grip" on harder surfaces. Another new feature is the provision of a small pulley at the top of the tripod by which a small rope can be used to haul up the heavy lifting block or to handle very light loads quickly. Every tripod is tested with a 50 per cent. overload, so that the safety of the user is always assured. It is worthy of note that even in the one-ton capacity the Tripod is light enough for one man to carry on his shoulder. Those who have had experience of hauling around the home-made wooden shear-leg will be able to appreciate this feature to the full.

Coming Road Congress in Chicago

Arrangements for the Eleventh Annual Convention of the American Road Builders' Association, which is to be held at Chicago, December 14-18 next, are nearing completion. We learn that essentially the same plan for the programme as that adopted at recent conventions will be followed. The various subjects to be treated have been so chosen as to cover the important phases of the three general divisions of the subject of highway work—Organization, Construction and Maintenance. Each topic will be introduced by a short paper presented by an authority especially selected for his knowledge of the subject on which he will speak. Among the topics to be treated are the following:—"Road and Pavement Dimensions—Widths, Depths and Crown;" "Road Foundations—Concrete, Telford, Gravel, etc.;" "Organization;" "Traffic—Present Tendencies, Probable Development and Regulation;" "Machinery for Construction and Maintenance;" "Brick Roads and Streets;" "Surface or Floors for Bridges;" "Bituminous Construction and Maintenance—Recent Practice;" "Concrete Roads;" "Recent Practice in the Construction of Wood and Granite Block Pavements;" "Earth and Gravel Road Construction;" "Street Paving in Small Cities;" "Convict Labor in Road Construction" and "Dust Prevention and Street Cleaning."

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**Alphabetical Index of Advertisers
Page 18**

Vol. 28 **October 14, 1914** **No. 41**

Principal Contents

The Survival of the Fittest ... 1257
What is Truth? ... 1257
Imports of Constructional Materials ... 1258
The Middle Course ... 1259
Does the Publication of Costs Endanger the Contractor? ... 1259
Trade and Market Conditions in Winnipeg ... 1260-1
Engineering Topics in the Old Land ... 1261-2
Special London, Eng., Correspondence
The Pacific Coast Highway ... 1263
Economics of Water-Waste in Cities ... 1264-70
By R. O. Wynne-Roberts
The Efficient and Inoffensive Treatment of Sewage 1268-72
By Rudolph Hering
Costs and Methods of Building Large Sewers ... 1272-75
By H. R. Abbott
Speculations on the Problem of Housing the Working Classes in Vancouver ... 1276-78
By R. McKay Frippe
Canadian Pacific Deck Plate Girder Spans ... 1278-9
Personal Mention ... 1279-81
Constructional News ... 1281-82

The Survival of the Fittest

OUR London correspondent's observations upon a certain class of trade and technical journals (in his letter published in this issue) are rather astonishing coming from England, for we had looked to the Old Country for a literary standard approaching infallibility. It is strange indeed to hear a complaint as to the "horde" which follows in the wake of the representative technical journals of Great Britain.

Undoubtedly this is the time for testing the real worth of the trade and technical press and ascertaining just which papers have the solid foundation to which so many lay claim. Without concentrating our energies upon the misfortunes of the weak we can emphasize the fact that in every field there are publications whose existence is always justified. Come peace or war, come prosperity or adversity, those journals whose pages are edited honestly and whose advertising is sold honestly emerge from a crisis like the present one stronger than when they entered, because ultimately they have the two-fold confidence of their former supporters and the added allegiance of others who have come to appreciate their solid worth. It takes a great shock or a sudden jar to bring some people to their senses, and it may take a war of the present magnitude to impress upon us the meaning of true economy in the field of the trade journal. In some respects war would appear to be not altogether an unmixed evil. The chastening influence must remain. The principle of the survival of the fittest applies to business and intellect, and to the products of business and intellect.

An improved standard may be expected for the reason that during the period of conflict the way of the trade paper will lie along a more rugged road than is travelled in times of prosperity, and that both editorial and advertising standards will be maintained with more difficulty. The standard of the journals which survive this strain must become higher. Their editorial observations will be stronger—presented always in clean-cut, concise English—and the marshalled facts, technical and otherwise, arrayed in the reading pages will be found to better advantage.

The present may be termed a time of compensation. Viewed in some ways depression is a misnomer. Aside from the war, we have to find our own level after a spell of prosperity which led to over-speculation and over-expenditure. In this compensating process the technical journal has a well-defined part and the fittest will survive for greater achievement. The fittest, be it said, are only those which have striven to represent the last word of advancement in the field they serve; whose articles, editorially and technically, have been uninfluenced by special interests, and whose advertising pages have been conditioned by no uneven favoritism.

* * *

"What is Truth?"

WE read in a well-known Chicago journal the comments of a writer stating that he remembers well the outbreak of the Crimean war and the "blue ruin" that was predicted for all industries and trades. He tells us that the reverse happened and that with the exception of the time of the trouble in the south there were never better times in the country before or since. He tells us that for a time money flowed like water, that the building trades boomed, that employment was plentiful, that hundreds of men—mechanics and others identified with constructional activity—returned to England to take part in the war, that many of these never came back, and that consequently times were good and many obtained an unexpected start in life—in short, that the nation profited immensely. These sentiments are expressed editorially in the October, 1914, issue of the National Builder.

It is our policy to place a broad construction upon optimism that is slightly overdone, excusing the fault on behalf of the spirit in which it was committed: we need optimism and we must not cavil over trifles. But can one accept such absurd statements as those of our contemporary's writer, whose memory in regard to the effect of the Crimean war upon American trade serves him so well? Many of the greatest industries in the United States have been built up of English capital, and England has never and can never pass through such an ordeal as a European war without depression ensuing on the American continent. Hark back another half century and witness the universal depression attendant upon the Napoleonic wars.

Prosperity and depression, and all the intermediate conditions, travel in cycles, and it is a long road in the cyclical movement that will take us to the time when money flows like water. The writer in the National Builder tells us that so long as the combatants confine themselves to cutting each other's throats the United States will go on prospering "with the same even tenor as during the past few years." In such prosperity, of course, Canada would share very largely.

Such optimism is of the variety known as optimism gone mad. The only optimism which can possibly appeal to intelligent men is the optimism which arises out of marshalled facts. Optimism is justified in view of the signal successes of the allies in the two months of the war's duration. Optimism may be found in establishing our manufacturers in colonial and neutral markets in certain lines of trade in which hitherto our enemies have transacted much business. There is optimism in the reflection that home manufactures will have to take the place of imported products. Optimism of this kind will result in a conservative, confident policy which must result in the maintenance of average business conditions and lead us back ultimately to prosperity.

For the month of August which was the first month of the European war, the total Canadian trade reached an aggregate of $100,374,000 compared with $97,832,000 for the corresponding month of 1913, according to a statement issued by Hon. J. D. Reid, Minister of Customs.

The Pennsylvania Railway is trying a rail weighing 120 lbs. per yard, so going one better than the 110 lb. rail used on the Lehigh Valley for heavy gradients and sharp curves. With these two exceptions the heaviest rail in the United States is one of 100 lbs. In the Pennsylvania new rail the head is 41 per cent., the web 22 per cent., and the base 37 per cent. The sides of the head have been given the steep slope of 8 deg., and the top has the short radius of 10 ins., the corner radii being 7-16-in. The fishing angle under the head is one of 18 deg., and above the base one of 13 deg. The height is 6¼ ins.

Imports of Constructional Materials

TALKING about optimism in its relation to marshalled facts, statistics are not lacking to prove that Canada now has an unparalleled opportunity to pave the way for greatly increased trade. Herewith we present a table of imports covering the leading lines of the constructional interests, showing Canada's purchases from Germany, Austria and other countries. They will repay the careful study of Canadian manufacturers seeking to divert trade to Canadian and British channels.

	Germany	Austria	other Countries
Asphaltum or asphalt	$ 9,259	......	$ 857,720
Baths, bath-tubs, basins, closets, lavatories, urinals, sinks and laundry tubs of any material	......	......	452,748
Bricks, tiles, clays	4,217	......	3,263,930
Cement	885	......	351,249
Cordage, rope and twine	1,108	2,417	3,788,936
Earthenware and chinaware	300,595	74,834	2,755,876
Electric Apparatus	204,388	21,767	8,698,159
Glass and Manufacturers of:			
Common and colorless window glass	2,708	......	1,494,714
Plate glass, not bevelled, in sheets or panes	7,081	......	912,842
Silvered glass, bevelled or not, framed or not framed	30,577	603	139,507
Other Glass	385,843	52,283	2,284,004
Glue, glue stock and mucilage	38,380	10,667	357,242
Gunpowder, explosives, etc.	61,844	......	1,221,573
Gutta - percha, India - rubber, and mnfrs. of:—			
Rubber and gutta-percha, crude caoutchouc or India-rubber unmanufactured	50,558	......	3,199,531
Lime	......	......	243,700
Marble and mnfrs. of:—	......	......	531,329
Metals and Minerals and mnfrs. of:—			
Bars, bands, hoops, rods, sheets and plates	55,137	......	28,468,573
Billets of iron and steel and ingots	68,728	......	4,280,423
Machinery	248,976	16,869	28,372,733
Nails and spikes	......	......	270,634
Pumps	21,279	......	....
Steel rails	2,289	......	4,920,506
Structural steel of every type	85,138	......	9,755,290
Tires, metal	348,059	......	204,680
Tools and implements	66,724	......	1,218,497
Tubing, brass, copper, iron and steel	539,130	......	3,711,725
Wire	140,523	......	4,226,713
Wire rods	51,574	......	1,638,615
Metals and Minerals and mnfrs. of, not included above:—			
Agricultural implements	......	......	3,274,693
Castings, iron or steel, N.O.P.	......	......	1,401,766
Cast iron pipe of every description	......	......	806,832
Cast scrap iron	......	......	491,377
Chains	......	......	611,545
Engines, locomotives for railways, gasoline, etc., including boilers	......	......	4,709,127
Fittings, iron or steel, for iron and steel pipes	......	......	1,019,805
Hardware, viz., builders' cabinet makers, etc.	......	......	843,486
Iron or steel nuts, rivets and bolts, with or without threads, nut, bolt and hinge blanks, T and strap hinges of all kinds, N.O.P.	......	......	285,606

Iron or steel scrap	......	......	611,546
Mould boards or shares or plough plates, land sides and other plates for agricultural implements, cut to shape from rolled plates of steel but not moulded, punched, polished or otherwise manufactured	......	......	227,518
Ore of iron	......	......	4,027,460
Switches, frogs, crossings and inter-sections for railways	......	......	282,724
Ferro-silicon, spiegeleisen and ferro-manganese	194,999	......	670,222
Locks of all kinds	4,354	......	456,239
Stoves of all kinds	9,408	......	826,570
Other iron and steel	392,153	12,066	13,085,095
Lead and Mnfrs. of—			
Old scrap pig and blocks.	......	......	464,842
Other lead and mnfrs. of.	10,441	1,547	466,506
Tin and mnfrs. of:			
Blocks, pigs or bars	......	......	1,959,940
Other tin and mnfrs. of ..	29,763	563	823,338
Zinc and mnfrs. of	108,736	81	761,146
Miscellaneous metals and minerals and mnfrs. of:			
Alumina	......	......	600,454
Aluminium in ingots, blocks, bars, rods, strips, sheets, or plates .	37,497	......	684,355
Aluminium, mnfrs. of N.O.P.	18,728	......	....
Gas, coal oil or other lighting fixtures, including electric light fixtures or parts thereof, metal, lava or other tips, burners, collars, galleries, shades, shade-holders	17,735	......	687,216
Ingot moulds, glass moulds of metal	......	......	254,282
Lamps, side-lights and head-lights, lanterns, chandeliers	137,710	177,078	1,196,499
Nickel, nickel silver and German silver, in bars and rods, in ingots or blocks, and also in strips, sheets, or plates .	......	......	144,343
Ores of metals	......	......	983,420
Platinum wire and platinum, in bars, strips, sheets or plates	......	......	116,698
Paints and colors	199,937	49	1,960,732
Hangings of wall paper, including borders	17,595	......	418,649
Tarred paper and other building paper, N.O.P.	......	......	513,329
Slate and mnfrs. of:—	6,077	......	229,961
Stone and mnfrs of:—	......	......	2,076,127
Tar and pitch	......	......	200,458
Varnish, lacquers, japans, japan dryers and oil finish, N.O.P.	......	......	167,326
Wood and mnfrs. of:—			
Furniture	6,873	22,220	3,020,781
Other wood and mnfrs. of	47,272	3,702	13,394,119

TORONTO leads in municipal work with operations involving an expenditure of nearly $3,000,000 under way or projected. Of this amount $1,500,000 is being spent on sewers and the balance on miscellaneous improvements, such as roadways, sidewalks and gradings. Apart from this work the city is building a new filtration plant at a cost of over $1,000,000. Good progress is also being made on the 84-in. steel pipe line across Toronto Island, the cost of which is estimated at $540,000. Additions to the pumping and distributing system will cost upwards of $50,000. The Works Commissioner, Mr. R. C. Harris, informs the Contract Record that the city will be able to complete without any difficulty the programme of work outlined for the season.

The Middle Course

THE Minister of Finance, Hon. W. T. White, in his recent public utterances, voices the exact sentiments of the more thoughtful of the Canadian people, when he counsels municipalities, railways and large industrial concerns to steer a middle course in carrying out their programmes of expenditure. Mr. White evidently has no sympathy with those manufacturers and others who, at the first sign of trouble, summarily dismiss their employees, and close and bar their doors, thus accentuating the difficulties which others, more loyal and sane, are endeavoring to forestall.

The middle course has already proved an eminently satisfactory one for business men throughout the Dominion. A readjustment is evidently taking place. As Mr. White says, the worst effects are gradually wearing away. Many of our industries have suffered, but on the other hand, many have been greatly stimulated. The higher prices for grain and other agricultural products will more than neutralize the shortage in amount. Increased agricultural production will be inevitable. This has been the great need in Canada for many years and will help to solve the problem of the high cost of living, with its attendant evils—the overcrowding of cities and consequent unemployment. As a result of the scarcity of certain raw materials, new industries will spring up, and with the increased demand for manufactured products, Canada has unexpectedly opened to her the means of becoming recognized as a manufacturing centre. The first duty of every Canadian is to put forth his utmost effort to increase production and add to the national wealth, not only that the wastage of war may be repaired, but also that the opportunities offered by the conditions which the war produces may be taken advantage of to their fullest extent.

Does the Publication of Costs Endanger the Contractor?

A SUCCESSFUL contractor whose practice it was to keep very careful costs of his construction operations once refused permission to publish some of these costs because they constituted his only stock in trade. This contractor was unusually expert in organizing construction forces, in selecting and handling men, in planning construction plants, in purchasing supplies and materials and he had a reputation for honesty and general reliability. His unit costs were less than those of his competitors; in general he bid more closely than did his competitors, and his profits were more certain and frequently larger than were theirs.

This example is not stated because it is exceptional. Many contractors refuse to permit publication of their costs. It is of course their privilege. To refuse publication on the plea that their "stock in trade" is thus made free to their competitors is, however, not logical reasoning. Considering the example cited, it is evident that these construction costs were not his "stock in trade," but were merely the results of his managerial ability and his business integrity which were his real "stock in trade." As we see it, this contractor and other contractors who conceal their costs fear two possible dangers from publication: First they fear that competitors will imitate their methods and be thus enabled more frequently to underbid them. Second, they fear that engineers knowing the actual costs may lower their estimates and force the contractor to take work at lower prices. Let us consider the force of these suppositions.

Personal knowledge of the operations of several competing groups of contractors in widely separated parts of the country is had by the editor. As a rule the contractors in each group operate in a limited area and bid against each other on nearly every job coming up during the course of the year. Although competitors, these men are usually friendly, clannish and even "chummy." They know each other and each other's methods thoroughly. Each man frequently visits the work the others are carrying on, often travelling considerable distances to do so. It is not necessary for one of these men to read about his competitor's methods since he is familiar with them as a result of direct observation. The experienced contractor knows a good method when he sees it and is quick to adopt it without any published prompting. He can tell at a glance if a job is being handled well and economically. As a result of this practice of inspection the alert contractors in any group employ substantially the same methods. Therefore the only ones who conceivably might profit from the description of a construction method to the disadvantage of the one giving out the description are familiar with the method before it is described. The reason for describing it is to help men in other localities whose operations, as a rule, do not interfere with those in the locality in which the method originated. Since costs are a direct result of conditions and methods there can be no more objection to their publication than to the publication of descriptions of methods. In either case objection to publicity is illogical since, as we have pointed out, methods and costs in any locality are continually undergoing a process of adjustment which trends toward a common level.

Nowadays nearly all engineers keep cost data with reference to the contracts under their charge. These data are kept with sufficient accuracy to serve the engineer's purpose in making estimates. While it is not the engineer's purpose to spy upon the contractor such cost data as he compiles are entirely adequate to show whether the contractor is making an exorbitant profit or not. Further than this, the engineer's interest in this connection does not extend. He expects the contractor to make a fair profit and is much distressed if the contractor is losing money. This is well shown by the fact that engineers usually make all the concessions possible when contractors are working at a loss. Therefore, since engineers keep cost data sufficient to their requirements, the contractor should not withhold the publication of such data in the belief that they will be turned to his disadvantage by engineers.

It should be borne in mind that there are other forms of valuable output data which can be published without throwing any light upon the contractor's profits whatsoever. Only cost data of the dollar and cent variety, covering the entire job, taken into account with the contract price, serve to indicate the contractor's profit or loss. If the contractor appreciates the value of giving publicity to his work and wants to help others without giving an insight to his profits he can readily do so.

It is seldom necessary, in fact it is sometimes altogether undesirable, to give unit costs for every item on a large construction job. Thus where a large part of a job consists of trenching and pipe laying, for example, and other less common features are included in the same contract, preference may well be given to the latter in giving out cost data. Thus the contractor may often give out highly interesting, valuable and complete cost data on a part of his job without furnishing any idea to the outsider of the amount of his profit or loss on his entire contract.

Again, where there is a large amount of trenching and pipe laying, as in the above illustration, typical sections 1,000 ft. or more in length may be selected for observation and subsequent publicity purposes, even if costs are not kept on the entire job, or if it is considered undesirable for any cause to give out costs relating to the entire job.

Finally, it should be borne in mind that one can entirely avoid the dollar and cent form of presentation and still give publicity to valuable data in a very convenient form. To the editor's mind one of the most valuable articles, giving output data, ever published in this journal occupied less than a column of space and didn't have a dollar sign in it. The article related to the laying of pipe sewers in a Wisconsin city. All the soil and other conditions were briefly but adequately described, as were the construction plant and methods employed. An intensive time study was made per 1,000 ft. of pipe line completed. The data obtained were recorded as so many days and fractions of days required by each class of labor employed in laying 1,000 ft. of sewer complete. This included supervision by foreman, the contractor's personal time spent on the work, etc. We commend this form of presentation to the contractor who has an ill-defined dread of seeing the dollar mark too prominently displayed in published accounts of his work.

Alert contractors are coming to appreciate the value of publicity. The benefits of publicity can be obtained as here suggested without revealing profits and without greatly reducing the serviceableness of the data made public. Moreover, as shown herein, the dangers arising from the publishing of even very full and complete data of the dollar and cent variety are largely but figments of the imagination.—Engineering and Contracting.

Trade and Market Conditions at Winnipeg

TRADE conditions in Winnipeg are not nearly as bad as many people believe. There are good sales in many lines, while others show signs of rapid improvement. There are a number of building blocks under construction, while the Government are expending a further $2,000,000 on new buildings. Civic improvement in the laying of sewers, etc., continues quiet.

The various firms interviewed are of the unanimous opinion that if the banks and loan companies would advance loans promised, trade would soon start up again. Many of the contractors are unable to finance work owing to trouble in this direction. Were the banks and loan companies less stringent, many contracts which are now closed down would be proceeded with, and market conditions would benefit materially.

There is a fair demand for the materials of construction. A slightly freer movement is reported in lumber, although conditions in the lumber industry leave a good deal to be desired. Market prices are still as quoted previously in our price list.

Firms handling cement report a good call for this product, as do manufacturers of steel and iron. Prices remain unchanged.

Business in the paint and oil line is very brisk—in fact one large firm reported that sales in this line fall short of those of last year only by a few hundred dollars. There is every likelihood of a good trade being quoted.

Sales are very quiet in the plaster of Paris, wall plaster, and sewer pipe lines, although there are signs of improvement. Prices are unchanged.

The demand for cast iron pipe continues to be fair. The price per carload lot, f.o.b. Winnipeg, is quoted at $38.

Engineering Topics In The Old Land

An Outcome of the War—The Situation and Outlook in the Timber Trade—Engineering and Sex—Licenses at Calgary

Special London, Eng., Correspondence to the Contract Record and Engineering Review

London, Oct. 13, 1914

THAT the technical press has been very hard hit by the war is not a matter of surprise, but it is really astonishing how many small papers have succumbed under the first undue strain placed upon them. The reason is not perhaps after all far to seek. Attached to the few standard papers, which are passably if not brilliantly edited, is a horde of papers of the limpet type, which batten upon the advertiser and suck him with leech-like assiduity. Their literary pages are a farce, consisting entirely of clippings, and even their editorials contain merely four or five lifted paragraphs tagged together by an ungrammatical and non-committal commentary. Contributed articles are the dodos of their pages. Their circulation—at least their bona fide circulation—is nil, and a quire of sales would lift their editor-proprietor-managers to the seventh heaven. Gratuitous circulation is what they depend upon, and they are not above making a boast of the important officials "who take it." Could the waste-paper baskets of these officials be inspected it would be found that not one in ten of the papers which arrive by post is ever stripped of its wrapper. There is a paper now which has, to the writer's knowledge, been running for over twenty years, and if its circulation has ever reached ten per issue the writer is open to weigh out a proportionate number of dollars for any home that may be running for the reception of decayed editors. Advertisements are obtained on the principle of "get what you can." If three pounds per page is too much, then take two, or one; and close the deal even at ten shillings. At every hazard the advertising sheets must be filled, and one good firm (even at ten shillings) spells many smaller firms at possibly paying rates. It is small wonder that with the temporary withdrawal of the advertiser such papers cease publication.

Timber Shortage

A shortage of the cheaper kinds of timber would have been a serious matter in this country, in view of the large quantities that are in requisition for the erection of temporary buildings and the carrying out of temporary works of varied character. Germany has declared Swedish deals, battens, boards, staves, and packing-case boards to be non-contraband of war, provided that they are carried in neutral bottoms. Finland, which exports a vast amount of timber to England, is of course Russian, and although Russia quickly removed her prohibition against the exportation of timber, sufficient awkward facts remain to reduce the customary shipments. A great quantity of timber of the cheaper kinds comes also from Archangel and other White Sea ports, and the trouble there now (according to one who is an authority on the matter) is the difficulty of loading, on account of the shortage of labour arising from the calling up of conscripts. "A friend of mine," (he writes) "sent a boat out at the commencement of the war, but it was returned empty because of the prohibition. He had £12,000 worth of Archangel deals and boards on order, which would have been very profitable to him during the coming winter, but he told me that he had since cancelled the order because of the difficulties of loading. If it could not be loaded before the White Sea had frozen (and the White Sea ports close earlier than any other timber exporting ports) he was afraid they might take fire before they could be loaded per 'first open water' in the spring. They have very frequent fires in Archangel on account of the tremendous quantities of timber stocked there, and the difficulty would be for him to prove that it was not his timber that got on fire. It is a very difficult thing to prove after a fire that it is or is not your timber that has been burnt, because there are thousands of other stocks of exactly the same size all piled together." The same authority is of the opinion that if the price of Baltic and Archangel timber goes much higher during the war, American spruce and cheap pitch pine will have to take the place of deal.

Engineering and Sex

At the beginning of the year 1910, the engineering world—or at least that section of it to which coal-gas manufacture and distribution specially appeal—was startled by the announcement that a lady had been appointed manager of the gas works at Magherafelt, County Londonderry, Ireland. There was no doubt as to her qualifications for the post. She had worked for thirteen years side by side with her brother, a gas-works manager in Kilkenny, and she was said to know almost as much about the work as he did. Some time previously a lady had been appointed surveyor to an Irish county or borough council (it is unimportant which) but the appointment was not finally ratified. Still, it showed the trend of events even then, and now one hears that the New Zealand Institute of Architects have admitted a lady to associate membership of their society. The time must necessarily come when women will have equal opportunities with men in all walks of life and when physical and mental attributes alone (especially the former) will decide the battle. The Royal Sanitary Institute admits both sexes, but of course that is not a professional body, its certificate being regarded as of little value except as a qualification (among others) for sanitary inspectorships. Many professional men use its agnomen, but only when they can place other, and higher, agnomina before it. The admission of both sexes has certainly cheapened the Institute "diploma," and it is to be hoped that the same misfortune will not visit the New Zealand Institute of Architects.

The Calgary Municipality

The "Municipal Manual: City of Calgary, 1914" is a compact little volume of nearly 300 pages, and reflects high credit upon its compilers. It gives English readers much food for thought, and should especially interest home engineers who contemplate seeking their fortune across the pond. Popular representation such as obtains here in the case of at least district councils has no place in Calgary, owing to the introduction of a property qualification. In England anyone, of either sex, may be elected a district councillor, provided that he or she "is a parochial elector of some parish within the district, or has during the whole of the twelve months preceding the election resided in the district." Hence, nearly every council contains its quotum of working men, and the engineer suffers accordingly! A most interesting study for the English reader is the list of licenses. It would seem as though almost everybody is licensed in Calgary, and it approaches the farcical when $5.00 per day has to be paid for "demonstrating self in window." Master and journeymen electricians and plumbers have to take out a license, as does a master gasfitter, but the journeyman gasfitter appears to be exempt. A premium is placed upon cleanliness by the licensing of chimney sweeps, house cleaners (when using machinery), scavengers, and window cleaners, and there really seems no reason (to take one instance) why if a man pays $20.00 a year for permission to clean windows he should not pay a similar amount for permission to clean doors or railings or front steps.

Still, there is wisdom in many of the provisions, and the authorities here might well consider the licensing of plumbers, electricians and gasfitters. The permit system, too, is a good one as applied to these trades, although it does not seem to be in operation in every case even in Calgary. Here, in free England, anyone may plumb, or gas fit, or electricise (to coin a word for the occasion) without let or hindrance, and the result is to be seen in work of the most disgraceful kind. Architects, surveyors and engineers appear to go license-free in Calgary, as they do here, and it is somewhat anomalous that the men who design the systems should not receive equal, if not more stringent, treatment than the men who merely carry them out. By-law 1502, which regulates the use of streets, deserves the final word, owing to its peculiarly contradictory enactments. First: No person riding in or driving any automobile shall go at an immoderate rate of speed in the streets. Second: Within the limits of the city the maximum speed shall be 6 miles an hour except approaching a crossing of intersecting streets, where the maximum speed shall be 5 miles an hour. Third: The limitation of speed to 6 and 5 miles an hour respectively shall not apply to automobiles or other vehicles propelled or drawn otherwise than by horses or other animal power and used solely for the conveyance of persons, for which the maximum speed shall be 10 miles an hour within the limits of the city, except approaching a crossing of intersecting streets, where the maximum speed shall be 5 miles an hour. Supplementary to these is a note to the effect that the Provincial Government's Motor Vehicles Act provides that the speed for machines of this nature shall not exceed 20 miles per hour, and that this Act takes precedence over the by-laws by any municipality in this respect, but does not over ride the provisions of by-law 1502 of the City of Calgary, governing speed which may be attained at street crossings. Calgary motor vehicles may therefore go at 20 miles an hour, a speed as great as that customary in London.

Among the several problems to be met in the recent construction of the concrete reservoirs in San Francisco was that of bonding asphalt to concrete. According to B. N. Abbott, in a letter to the Engineering Record, after making unsuccessful attempts to apply the asphalt direct to the concrete in various ways, the expedient of first painting the surface with coal tar was tried, and it was found that when applied in this way under right conditions the asphalt would adhere so firmly that after it had cooled it could not be broken away without bringing pieces of concrete with it. Mr. Abbott states that in order to secure this result the concrete surface was first scrubbed clean with a bristle brush, and over this a thin coating of hot coal tar was "painted." The coal tar should be heated in small quantities, brought just to the boiling point, and then applied immediately. Heating the coal tar in large quantities, which necessitated some delay before it could all be used, did not give such good results, and the men were therefore not allowed to heat more at a time than they could apply quickly as soon as it began to boil. The asphalt was spread over the tarred surface in the usual manner.

In connection with the construction of the three-mile Mount Royal tunnel of the Canadian Northern Railway at Montreal, six small storage battery locomotives are being used to haul 175 tunnel dirt cars. The storage batteries are carried on trailer cars, there being two batteries for each locomotive. These locomotives were originally operated by petrol engines. It was hoped that the carbon monoxide in the exhaust could be changed to dioxide by passing over lime, but this was only partly successful. The fumes finally became so objectionable that 110-volt electric motors were substituted for the engines, the locomotive gearing being left practically without change and the trailer car with a sixty-cell storage battery being added to each locomotive to supply the current. Recently, since the hauls have become longer and a larger tunnel cross-section has been available so that a trolley wire could be used, these same locomotives have undergone still another change. A trolley pole and another 110-volt motor have been added, the two motors operating in series and being supplied with 220-volt current from the trolley wire.

Pursuant to a request made to the Dominion Government for the granting of some measure of assistance toward the development of iron ore mining in Canada, and in accordance with the statement of the Minister of Finance in his budget speech during the 1913-14 session of Parliament, that the iron mining industry would be investigated, a Committee has been appointed to enquire into the situation and report the facts to the Government. Every owner or operator of an iron ore property in Canada should be interested in facilitating this enquiry and communicate with the Deputy Minister of Mines at Ottawa, or the Secretary of the Committee, who will furnish a schedule of questions covering the information required by the Committee.

The Pacific Coast Highway

In addition to the great Canadian automobile highway now in course of construction from the Atlantic to the Pacific, of which Vancouver is the western terminus, the Pacific-coast highway extending from San Diego to Alaska via Vancouver is being linked up, and by the end of 1915 motorists will be able to make the trip from southern California to British Columbia over a hard-surfaced road. The route will include the principal cities on the coast and will afford one of the most attractive motor trips on the continent.

Approximately $7,000,000 was spent on road building in British Columbia in 1913, and every settled section of the province is being provided with good roads. As practically all the original transportation routes in this district were from east to west, special attention is now being given to the building of north and south lines of both highways and railroads. The purpose is to open up lines of coastwise communication connecting the main arteries of traffic extending from the eastern and central provinces to the Pacific coast. This is especially true of motor roads, and at the present rate of progress in construction British Columbia will soon be provided with highways suitable for motor traffic from the border of the United States to Yukon Territory.

That portion of the British Columbia section of the Pacific highway from Vancouver to Blaine, Wash., was recently definitely marked, and other divisions in the province are being connected. For several years various sections of good motor roads along the coast have been in use, but only within the last few years has there been a concerted effort to connect the completed divisions, making one continuous highway through the Pacific Coast States and British Columbia.

The plan of the Pacific Coast Highway Commission, which initiated and has been the moving factor in the construction of a motor trail along the Pacific coast, is ultimately to include Yukon Territory and Alaska in the route. Great progress has been made this year in road-building in Yukon, among the most important stretches of which is the overland road between Dawson and Whitehorse, on which grades are being reduced, sharp curves eliminated, and fills and surfacing added. One of the most important improvements on the road near Dawson is the straightening of the highway on the east side of the Ogilvie River, where the road was destroyed by dredges last year. The old roadway followed a tortuous course which made travel dangerous, especially automobile traffic, because of the steep grades and curves. The plan of the Yukon Territorial government is to improve the existing highways and construct new roads, establishing a system connecting with routes through British Columbia and the new roads being built in Alaska, extending the automobile route from the semi-tropical regions of the coast to the land of the midnight sun.

The engineers detailed by the Alaskan Road Commission to survey the proposed Government highway from Skagway to the summit of the White Pass have completed the work and are now preparing maps and data for the route. The road is to connect at the international boundary line at the summit of the pass with the Canadian system of roads reaching to the Atlin section, and to Yukon as far north as Dawson. The road from Skagway to the summit will have a grade averaging less than five per cent. and at no place will it exceed eight per cent.

According to the new survey the route follows for the greater part of the distance the old '97 trail, leaving out that section of the road leading to Black Lake, but continuing on the west side of the Skagway River to Rocky Point, avoiding the long, steep grade to Black Lake. The route passes through historic Liarsville, a former lively station on the '97 trail, from where it approaches a sheer wall of granite, which will require either trestle work or extensive cribbing for a long distance. At Mile No. 7, of the White Pass & Yukon Railway, the great scenic beauty of the road becomes apparent, and the route continues to increase in attractiveness as it winds up through the rocky canyon of the Skagway to White Pass City, once an animated municipality living on the adventurous gold seekers passing to and from the mining regions farther in the interior, but now reduced to a deserted village consisting of a few uninhabited cabins. The scenic aspect of the road continues to grow in interest until the summit of the pass is reached, and the route, when completed, will present attractions that will make it one of the great popular thoroughfares of the Northwest for summer tourists and motorists.

With the completion of this route, motorists living in any section of the coast country will be able to make the journey from southern California to Alaska, with such side trips as they may desire to include. The popularity of the Pacific-Coast highway is assured, as it passes through a country possessing special scenic attractions, and in which, most of the way, during the greater portion of the year, good weather and favorable conditions are assured.

The great continental and coast highways will make Vancouver the objective point for motorists from the East and South.

A particularly smart piece of work in the way of installing electrical machinery and erecting poles, has just been carried out at Sheds No. 24 and 25 on the Montreal Harbour. The Government decided to fit up these sheds for baling compressed hay for the cavalry which are going to the front, and to obtain the necessary electrical power, a new line had to be constructed and machinery installed. By working day and night the poles were put up, the buildings wired, and the machines installed in a very short time. Sixteen very heavy compressing machines are now in operation. These are electrically driven, the current being supplied by the Montreal Light, Heat and Power Company over a special line. It is transformed from 2200 volts to 550 volts, three 75 kw. transformers being used. The Government purchased four 100 h.p. Canadian General Electric motors, each motor driving four compressing machines. The small sub-station in which the transformers are located was partially built, and the remainder of the work was done under great pressure.

A direct outcome of the war is the opportunity afforded Canada of increasing her sales of iron and steel manufactures, as she is already exporting to the value of ten million dollars annually. Special attention might be given to nails, hitherto purchased in large quantities from Germany.

Economics of Water-Waste in Cities

The Increased Cost of Constructing and Operating Water and Sewerage Works Brought About by Waste—The Cost of Water and Sewer Service in Two Hypothetical Cities—Statistics of Canadian, U.S., and European Cities

Contributed by R. O. Wynne-Roberts, M. Inst. C.E., M. Can. Soc. C.E., F.R. San. Inst., Consulting Engineer, Regina, Sask.

A perusal of the technical press and of the papers and discussions at the various conventions of engineers will indicate that the subject of water consumption and waste is one of considerable importance.

That water is being wasted in cities is recognized by engineers, and that it cannot be completely eliminated is admitted by all. But the quantity which is used or wasted in excess of allowable or unpreventable waste, plus that actually consumed for all legitimate purposes, represents a tangible and potential source of wealth. The means by which such wealth can be conserved is dependent on the method adopted and the manner in which it is organized.

Mr. R. O. Wynne-Roberts.

The influences which affect the consumption of water are the nature of the industries, the wealth and habits of the people, the extent to which water is used for fountains or other ornamental objects, watering of lawns, street sprinkling and other public purposes. Climate has also a very considerable influence, especially as to the amount used for sprinkling purposes, and that which is wasted in winter to prevent freezing. It is probable, however, that the most important factors in determining the consumption of water are the degree of care taken to detect leakage and other waste, and the fact as to whether the water is sold by measure or otherwise.[1]

It will be assumed that the actual consumption of water on the North American continent is on a more generous scale, and that the climate as a rule is less humid and consequently the gardens and streets receive more watering than in Europe. This, however, cannot account for the great difference in the average consumption per capita.

While it is not always a sure method of comparison to consider the consumption in any one city with that of another, owing to the different conditions which obtain, when several cities are compared, the above statement loses some of its force.

On the following page there is a list of a few Canadian and American cities selected at random from references in various papers and reports.

Chicago has about the same population as Vienna, but the quantity of water consumed is over 15 times as great. Ottawa is about the same size as Devonport, but uses about 4½ times as much water. Montreal and Newcastle-on-Tyne are nearly similar in size, but Montreal uses 3½ times the volume of water used in Newcastle. Milwaukee and Frankfort-on-the-Maine have approximately the same number of inhabitants, yet the former uses three times the quantity of the latter. Basel, in Switzerland, and Buffalo, in New York State, are nearly alike in population, but Basel uses only one-eighth as much water. New York City, the greatest city of the West, requires 2½ times the quantity needed in London, Eng. The reader who will continue the comparisons will find material for thought and investigation. There are, of course, certain conditions in Europe which tend to keep the consumption low and these should be studied so as to arrive at a reasonable comparison. Such conditions are the number of faucets fixed on services, types of dwelling, methods of living, density of population in certain quarters, and so on.

In Germany, an allowance of 100 litres per capita per day is ordinarily considered ample for all city uses. This is equal to 27 U. S. gallons. Mr. Edward S. Coles, in a paper read before the American Waterworks Association in 1912, presented a list of British cities, the average domestic consumption in which was 29.8 U. S. gallons and the average trade consumption 13.6 gallons, or a total of 43.4 gallons daily per capita.

Even granting that the actual use of water for ablutionary and other purposes is more generous here than in European cities, it is palpable that the excess will not be great.

An American authority[10] estimates that the daily average for domestic purposes would be 25 gallons per capita, for commercial purposes 20, for public purposes 5, for loss 20 —total 75 gallons per capita.

There are many cities in the United States and Canada that are thriving on a smaller average. Domestic allowance of 25 gallons daily per capita is more than ample, and when it is borne in mind that a large number of industries, railways, etc., do not use city water, as a perusal of Cincinnati Sewerage and other Reports clearly shows, an allowance of 20 gallons per head per day for industrial consumption is high. The loss of 20 gallons is excessive, while the preceding allowances evidently include waste also.

The average consumption of the European cities cited is about 40 gallons per head per day. If this figure is increased by 25 per cent. it will represent a reasonable quantity and include unpreventable waste, which occurs in all cities.

The writer will for the purpose of this article assume two hypothetical cities, each of 250,000 inhabitants. One city will consume 50 gallons per capita daily, and the other 150 gallons. Approximate estimates, based on published statements which will be quoted, will be submitted to show the economics of waste. The water is supposed to be filtered, chlorinated and pumped 200 feet high or equivalent in pressure, and distributed. The sewage will be collected on the separate system and treated bacteriologically.

There is ordinarily one ratepaying consumer in every six inhabitants, so that in each city of 250,000 population there will be about 42,000 water consumers.

The daily consumption of water will average 250,000 × 50 = 12,500,000 gallons and 250,000 × 150 = 37,500,000 gallons. To these figures must, of course, be added an allowance in capacities of mains, pumps, etc., to meet the fluctuating hourly flows.

The waterworks of the six largest cities in Wisconsin[11] supplying an average of 81 gallons per head daily, cost about $187.25 per consumer, but eliminating one city, where the cost exceeded the average by nearly 100 per cent., the mean of five cities was $151.42 per consumer. Accepting this as the basis of cost, the water-works system for a city of 250,000 inhabitants, or 42,000 consumers, will be about $6,360,000. It is therefore reasonable to estimate that for 50 gallons per head daily the cost will be about $6,000,000 and for 150 gallons per head $7,000,000. The extra $1,000,000 will annually cost 5 per cent. for interest and say 2½ per cent. for depreciation, a total of $75,000 per annum.

The cost of pumping water will be about six cents per million foot gallons,[12] so that 12.5 million gallons raised 200 feet will cost about $54,750, whereas 37.5 millions raised to the same height will cost $153,250, an extra cost of $109,500 per annum. The average cost in 21 cities in Wisconsin in 1911 was $16.70 per million gallons pumped. On this basis the annual cost would be $76,000 and $228,000 respectively.

Filtration and sterilization will cost about $3.37 per million gallons,[13] to which is added the cost of pumping into filters, making a total of $3.50. So that in the first city this work will cost about $16,000 and in the second $48,000—a difference of about $32,000 per year.

The distributing mains sufficient for domestic, industrial and fire purposes should satisfy the National Board of Fire Underwriters' standard (1910) and also allow for the usual maximum fluctuations in consumption.

The National Board of Fire Underwriters' general requirements may be expressed by the following equation:

$$Y = 1020 \sqrt{X}\,(1 - 0.01 \sqrt{X})$$

Y = gallons per minute. X = population in thousands.

The cities under consideration have about 250,000 population, so that to satisfy the above requirements

$Y\ 1020 \sqrt{250}\ (1 - 0.01 \sqrt{250} = 13{,}570$ gallons per minute.

The consumption of 12,500,000 gallons per day is equal to an average of 8,700 gallons per minute and 37,500,000 gal-

Statistics of Canadian, U. S., and European Cities

City	Province or State	U.S. Gallons per capita	Population	Source of Information
St. John	N.B.	250	42,500	Canadian Commission of Conservation
Vancouver	B.C.	164	120,000	Canadian Commission of Conservation
Halifax	N.S.	260	46,600	Canadian Commission of Conservation
Quebec	Que.	161	78,200	Canadian Commission of Conservation
Hamilton	Ont.	148	81,000	Canadian Commission of Conservation
Ottawa	Ont.	220	87,000	Special Committee Report
Toronto	Ont.	120	450,000	Canadian Commission of Conservation
Montreal	Que.	130	555,000	Hering & Fuller Report, 1910
New York City	N.Y.	111	4,800,000	(2)
Buffalo	N.Y.	321	425,000	(2)
Chicago	Ill.	235	2,200,000	(2)
Philadelphia	Pa.	205	1,600,000	(2)
Milwaukee	Wis.	115	410,000	1913 Report
Kansas City	Mo.	126	300,000	1913 Report
Cincinatti	O.	131	392,000	1913 Sewerage Report
Pittsburg	Pa.	197	550,000	(2)
St. Louis	Mo.	109	687,000	(2)
Cleveland	O.	102	560,000	Toronto 1912 Report
Detroit	Mich.	173	466,000	(2)
Baltimore	Md.	115	560,000	(2)
St. Paul	Minn.	61	210,000	
New Orleans	La.	53	370,000	1913 Report
Boston	Mass.	108	733,000	1913 Report
Albany...	N.Y.	242	101,000	Engineering Record, Aug. 3, 1912
Salt Lake City		400		Engineering Record, July 26, 1913
The following are the statistics of a few European cities:				
Vienna	Austria	15	1,800,000	(3)
Aachen	Germany	25		(4)
Frankfort-on-Maine	Germany	46	400,000	(5)
Wiesbaden	Germany	28	100,000	(3)
Hamburg	Germany	44	757,000	(3)
Munich	Germany	45	524,000	(3)
Berlin	Germany	22	2,100,000	(3)
Basel	Switzerland	42		(4)
Copenhagen	Denmark	47		(4)
London	England	43	6,721,207	1913-14 Report
Liverpool	England	36	960,000	(6)
Newcastle-on-Tyne	England	36	590,000	(6)
Hull	England	49	250,000	(6)
Manchester	England	42	1,200,000	(6)
Devonport	England	51	75,000	(6)
Glasgow	Scotland	72	1,150,000	(6)
Nuneaton	England	21	37,000	(7)
Stirling	Scotland	64	28,000	(7)
Plymouth	England	47	152,500	(8)
Sydney	Australia	48	668,000	(9)
Riga	Russia	25		(4)
Weardale and Consett	England	22	400,000	Letter

lons daily represents an average of 26,000 gallons per minute, but the maximum rate will probably be about 150 per cent. of the average. Therefore the relative requirements of the two cities will be as follows:—

	No. 1 City	No. 2 City
Fire purposes	13,570	13,570
Domestic and industrial purposes.	8,700	26,000
Add 50% for max. hourly demand.	4,350	13,000
Total gallons per minute	26,620	52,570

In other words, the capacity of the mains in the city No. 1 will be only one-half of that in No. 2.

According to published statistics[14] distributing mains absorb about 64 per cent. of the total capital expenditure. There are other published figures which conflict with this percentage, but as the above result was evidently obtained by careful analysis of at least 22 different city waterworks, it may be taken for granted that it is reliable. The cost of the distributing mains in No. 1 city will therefore be about $3,840,000 and in No. 2 about $4,480,000 and additional expenditure of about $640,000. The cost of operating distribution works may be estimated at $2.50 per million gallons pumped[15] which in the first city would amount to about $11,400 and in the second to about $34,200—a difference of $22,800 per annum.

After having distributed the water to the people, the city must also provide sewers to drain it away after use or misuse. The lateral sewers are, of course, designed for flows which, normally, will only partially fill the pipes. The trunk sewers must be calculated so as to be ample to accommodate the districts served.

Supposing it were necessary to provide one main conduit to the outfall works, that the grade were 1 in 5,000 and that no ground water were admitted, the diameter of such a sewer to convey 12.5 million gallons per day would have to be about 54 inches and for 37.5 million gallons 82 inches. This does not take into account the hourly fluctuations, otherwise the diameter would have to be larger in each case. Accepting Cincinnati prices,[16] the cost of these conduits would be:

54-in. Diameter Sewer	
Trenching 8 yds. at $1.25	$10.00
Concrete, 1.38 yds. at $15.00	20.70
Cost per foot run	$30.70
82-in. Diameter Sewer	
11.3 yds. at $1.25	$13.95
2.24 yds. at $15.00	33.60
	$47.55

That is, to convey three times as much sewage as would be required economically, the ratepayer would have to pay about 60 per cent. more in capital expenditure (and, of course, in annual taxes for interest and maintenance) on such trunk sewers. When the costs of vitrified pipe sewers are analyzed, it will be found that the extra cost for sewer laid to carry, say, 1,200 gallons per minute and 3,600 gallons per minute will be in the following ratio:—

15-inch pipe, grade 1/600	
Vitrified pipes	.75
Trenching 10 feet deep	.70
Total per foot run	$1.45
24-inch Pipe, Grade 1/800	
Vitrified pipes	$2.00
Trenching 10 ft.	.70
	$2.70

The extra cost is 86 per cent., so that the additional cost to convey three times a given volume of sewage increases as the diameter of the sewers diminishes. The cost of sewering a city is probably about the same as to provide water mains, perhaps more, because water mains operate under pressure and sewers by gravity; the former are always full, while the latter are generally only partially full and consequently larger in diameter or dimensions. Many of the lateral sewers could not be reduced in size even if the water consumed were maintained at 50 gallons per capita, but many of the larger sewers could, and the saving in capital expenditure would be tangible.

The next item of expenditure is for sewage disposal works. Whilst to some degree, it is true that an extravagant use of water does not necessarily entail the construction of works to treat sewage in proportion to the flow or volume, it nevertheless means works of a greater capacity than would be necessary in the case of an economical water consumption, for tanks and pumps must be in some relation to the hourly quantity of sewage. The capacity of the pumps (if any) must be more than equal to the maximum hourly flow of sewage, with reserve pumps and power as well, in case of breakdowns or other contingencies common to such plant. The velocity of the flow of sewage through the tanks must not for long periods exceed a critical limit. To attain this condition it is evident that tanks capable of treating 37.5 million gallons daily will be much larger than would be necessary for a discharge of one-third that volume.

Mr. George M. Wisner in his report[17] supplies an interesting table of costs which is copied below:—

Type of tank	Nominal period of settling	Gallons per capita	Cost per capita
Emscher	3 hours	200	$1.44
Dortmund	4 hours	200	$0.84
Straight flow	8 hours	200	$0.77
Straight flow	6 hours	200	$0.58

As Emscher or two-storey tanks are now prominently before us, its estimated cost per capita will be provisionally accepted. To maintain the same velocity for 150 gallons per capita daily, the cost will be

$$\$1.44 \times \frac{150}{200} = \$1.08 \text{ and for 50 gallons per day } \$1.44 \times \frac{50}{200} = \$0.36.$$

The writer does not contend that the cost of these tanks will be in strict proportion to the flow of sewage, as there are items of expenditure which are not proportionate; still, taken as an entity, the cost will not seriously exceed the above. Mr. Clark when discussing a plant in course of construction in Baltimore, stated that the detention period with Emscher tanks would be two hours[18]—the ordinary standard detention period—consequently to maintain this detention period as closely as possible the number or sizes of the tanks must in the cases under present discussion be approximately in the same ratio as to dimension and cost. But to allow for contingencies, assume that the cost would be $1.10 and $0.40 respectively per capita, then, 250,000 × $1.10 = $275,000, and 250,000 × $0.40 = $100,000, a difference of $175,000, which at 5 per cent. interest and 2 per cent. maintenance, etc., means $12,250 per annum.

Perco-filters again are designed to deal with about 2,000,000 gallons per acre daily. The Columbus filters were designed for this rating. Mr. George W. Fuller states in his book that his practice has been to specify for average conditions, a 6-foot filter at an average rate of two million gallons per acre per day.[19] This would be for a sewage flow of separate sewers approximately 100 gallons per capita daily. It is contended that perco-filters will deal with approximately the same quantity of organic matter per acre per day, regardless of the degree of dilution—in other words, the organic matter from a residential city will, in the aggregate, amount roughly to the same quantity whether it be contained in a large or small volume of water. The British Government (Local Government Board) ordinarily requires in the case where there is no land for subsequent treatment or a large river for effective dilution, a filter 6 feet deep and one acre in area for each million gallons of sewage dry weather flow, but when, as is the practice in America, a river is available for the ultimate oxidation of the filtrate, then the area is about one-half. It is therefore reasonable to postulate that for a consumption of 50 gallons per capita daily the area of filter will be about one acre per million gallons and for 150 gallons per day an area of one acre for each two million gallons, on which basis the respective areas will be about 12½ and 18¾ acres. A reserve must be added—say, ten per cent.—which will increase the areas to 13.75 and 20.625 acres. Mr. Wisner estimates the cost of perco-filters at about $28,000, while according to the experience of other cities the average was about $38,000.[20] Basing the cost at $30,000 per acre the first case will require an expenditure of $412,500 and the second $618,750—a difference of $206,250, which at 5 per cent. interest is equivalent to an annual burden of $10,312. The cost of operating and maintaining these filters may be placed at $2.00 per million gallons.[21] This will amount to 12.5 × 365 × 2 =$9,125 and 37.5 × 365 × 2 = $27,375.

Sterilization of the filtrate by hypochlorite of lime costs about $1.67 per million gallons treated,[22] when 4½ parts of available chlorine per million parts are applied. This for the first case would mean $7,620 and in the second $22,860.

Summarizing the items already mentioned in the foregoing observations, the following results are obtained:

	No. 1 city consumption 50 g.p.c.d.	No. 2 city consumption 150 g p.c.d.
Interest and depreciation on total capital on waterworks, per annum	$450,000	$525,000
Annual cost of pumping	54,750	153,250
Annual cost of filtration and sterilization	16,000	48,000
Annual cost of distribution works	11,400	34,200
Total on waterworks	$532,150	$760,450
Annual cost of operating sewage tanks, plus interest	$ 7,000	$ 19,250
Annual cost of operating perco filters plus interest	29,750	58,312
Sterilization of filtrate	7,620	22,860
Total	$44,370	$100,420

Adding the two expenditures together we arrive at a rough idea of what it means to the ratepayers:

	No. 1 City	No. 2 City
Waterworks	$532,150	$760,450
Sewer works	44,370	100,420
Total cost	$576,520	$860,870

The difference of $284,350, capitalized at 5 per cent., will represent a decent sum of $5,687,000.

The writer has advisedly adopted published figures and in doing so has quoted the authorities, but it is manifest that the above estimates serve only as indications, and therefore each city must be considered separately, although the foregoing statistics answer as direction posts to those who will analyse carefully the financial results to be obtained in their own cities. The foregoing will afford a sufficiently safe basis to warrant a close scrutiny into the relative cost to the ratepayers of an economical versus an extravagant consumption of water. Furthermore, in those cities where the water supply is controlled by companies, the foregoing observations will suffice to show what waste means to them, and to their customers. The dividend-producing power of any franchise depends on an efficient management and this in its turn means the stoppage of all preventable waste.

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A dam 325 feet long between abutments has been built at Fenelon Falls, Ont., for the Dominion Government, by Messrs. McPhee & Kehoe, of Brechin. The structure takes the place of an old wooden dam which was in service for many years. There are twelve large reinforced piers with grooves for holding the stop-logs. A track provides for conveying the machinery necessary for adjusting the stop-logs. The total cost of the work has been approximately $55,000.

The harbor works at St. John are being pushed with the greatest vigor in anticipation of an increased traffic in grain and other food stuffs between Canada and Great Britain this winter. The new pier, which will probably be utilized by the steamers of the Canadian Pacific Railway, will be ready for business on the first of December. A large warehouse is now in course of erection, and an elaborate scheme of reclamation is being carried out with a view to providing enlarged trackage facilities.

The following is the 1914-15 programme of the Canadian Society of Civil Engineers. The meetings will be held at the Society's headquarters, 176 Mansfield Street, Montreal: October 22, general section meeting; November 5, monthly meeting; November 19, electrical section meeting; December 3, mechanical section meeting; December 17, monthly meeting; January 7, mining section meeting; February 4, monthly meeting; February 18, general section meeting; March 4, monthly meeting; March 18, electrical section meeting; April 1, mechanical section meeting; April 8, monthly meeting; April 22, mining section meeting. Mr. Walter J. Francis is Chairman of the Committee on Meetings.

There is further trouble with the proposed new building by-laws for Montreal, and the adoption of a new code is still a long way off. More than two years ago the drafting of the code was put into the hands of a committee representing the architectural, engineering, and contracting interests, and in turn the duties were delegated to Messrs. W. J. Francis and J. Venne. These gentlemen, after many sittings and the lukewarm support of the City Council, drafted a number of by-laws, which it is understood were sent direct to the Council without being referred to the general committee. The Council asked the law department to study the code, and this entailed further delay. The City Attorney's report is to the effect that the proposed new code will require revision to weld it into a harmonious whole. The matter has been referred to the Legislation Committee of the Council.

The Efficient and Inoffensive Treatment of Sewage*

By Rudolph Hering, D.Sc., C.E.

SINCE the introduction of water supplies into cities the subject of sewage treatment has become an important one in many cities. The water as it passes through the city receives the dirt, dust, and excremental discharges from our houses and, together with rain water, also the dirt and dust that has accumulated upon the streets, roofs, etc. We have turned the clean water furnished us into dirty water, then called sewage, which is discharged into sewers and reaches the nearest watercourses and, with them, finally the ocean.

Dr. Hering.

As cities grew and the watercourses were small their water frequently became offensive. The heavier matters were deposited in the streams as sludge and putrefied, while the flowing water was deprived of its dissolved oxygen, and both sludge and water became offensive.

It was found later that diseases were caused by certain bacteria which were discharged from our bodies while sick, and entered the sewers and the streams. Sometimes these germs became free and infected the air, or the polluted water was used in such ways that the germs entered human bodies and made them sick. Gradually, therefore, the sewage question became not only one of convenience of city life but one of health.

The first serious troubles were experienced in England, where the communities are crowded and the rivers are small. England had also been the first country to generaly introduce modern water supplies into houses. Many of its rivers soon began to get foul and sometimes dangerous to health. Therefore the subject of sewage collection and disposal received most attention and the first satisfactory solutions in England.

To-day we have reached the conclusion in all civilized countries that it is practicable and economical to collect sewage from houses and cities, and to carry it away underground in sewers, to be delivered either into flowing streams or onto land in such ways that it will neither become a nuisance nor be of any injury to health.

We can now design the house sewers or drains and the receptacles of the waste water in such a way that by cleanliness and proper ventilation we need not have a nuisance in the house nor give disease germs in the sewage an opportunity to enter the same. We can now design the city sewers in a way so that they can carry the sewage or dirty water from the houses to the outfalls without causing any nuisance or danger to health on the streets.

There are many cities, particularly in Europe, where there is no offensive odor within the sewers. In Paris, Hamburg, Wiesbaden, and other cities even visitors regularly inspect them who desire the sensation of passing through these waste-water channels under the streets. I feel satisfied that it is only a question of time when in all cities we shall have our sewerage systems so built and maintained that no more offence will arise from them than we now expect in our bathrooms, water-closets, or kitchens.

When the sewage from the house gets into the sewer it consists of liquids and solids. At first nearly all of the matter which is liable to become offensive is in solid form. The sewage can be strained when leaving a house, and the liquid on standing will rarely, if ever, become foul, because whatever little dissolved organic matter it may contain is oxidized by the large quantities of dissolved oxygen. As the sewage runs on the solid matter is more and more dissolved. After a mile or two, and generally at the outfalls, we find that about one-half of the waste organic matter is in solution. After flowing many miles a still larger part is dissolved.

It is important to realize this last fact, because the question of sewage disposal and treatment is very much dependent upon the physical condition of the sewage and whether there is much organic matter in solution or not.

The nuisance resulting from sewage is caused by the gradual exhaustion by this matter of the oxygen dissolved in the water. Organic matter as it decomposes first consumes oxygen, and when the latter is all gone an entire change takes place in the process, and hydrogen is then consumed. The first process we call putrefaction, and it is quite offensive. It is the condition which we have tried to prevent and can now prevent, knowing better than formerly the conditions under which it occurs.

Both oxidation and putrefaction are accomplished by the action of bacteria, which fact, as it concerns sewage, has been known only for the last thirty or forty years. Since the discovery of bacterial action in converting dead organic into mineral matter we utilize two classes of bacteria for this purpose. One class is that of the aerobic bacteria which cause oxidation in the presence of oxygen; the other class is that of the anaerobic bacteria which live in the absence of oxygen. We are concerned, however, with two orders of anaerobic bacteria. One produces putrefactive or offensive conditions, the other does not. This fact has been applied to sewage treatment only within a few years. The latter kind are not putrefactive; they decompose the sewage without oxidation and yet do it in an entirely inoffensive way. Offensiveness is caused by the production of bad-smelling gases, of which the principal one is sulphuretted hydrogen. We can now prevent the development of sulphur bacteria, which produce this gas, by creating conditions which allow other bacteria to develop which marsh gas and carbon dioxide, neither of which is offensive. In the modern methods of sewage treatment we therefore endeavor to utilize the aerobic bacteria, and, of the anaerobic bacteria, chiefly those which produce marsh gas and carbon dioxide. This practice constitutes the greatest progress we have made in sewage treatment during the last few years.

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* Extracted from a paper presented at a meeting of the Mechanical and Engineering Sections of the Franklin Institute.

We can now say that the entire process of sewage collection and disposal, from start to finish, can be conducted inoffensively. We do not hesitate, as we did less than fifty years ago, to have a bathroom next to our bed or living-room. The kitchen sink has less odors than formerly. Street sewers in many cities are no longer offensive.

We have not yet advanced as far as this in all street sewers, particularly in our country, because they are not all properly built nor cleaned. The suspended matter carried by the sewage is frequently retained either by deposit or by the roughness of the sewer lining or by eddies formed, where the flow is not regular. In such cases where the retention is more than a day the dissolved oxygen becomes exhausted and putrefaction begins. To prevent this retention the sewage must have a steady and regular flow and rapid velocities, and the interior surface against which the sewage flows must be as smooth as practicable. All the progress in city sewerage that has been made in the last fifty years has been along these lines, so that as a result thereof the sewage not only is devoid of odors in the sewer but is delivered at the outfall with a remnant of dissolved oxygen and without putrefaction. In fairly good-sized towns properly sewered and where the sewers are kept clean I have never observed at the outlet anything worse than a stale odor.

To get this result we should also have proper means of flushing the sewers, and also of well ventilating them so that they contain fresh air at all times. The oxygen of the air replenishes what is being exhausted by decomposing matter in the water and by the temporarily stranded matter along the sides. In Europe it is customary to flush the smaller sewers once or twice a week, the larger ones once or twice a month. In our country we do not yet flush the sewers as much as we should, and in most cities the flushing is left to the rain-water which enters occasionally. Rain-water flushing may prevent serious deposits, but it will not prevent temporary deposits which produce the objectionable odors. Small sewers are flushed by automatic flush tanks, which generally keep the smaller sewers in a better condition than the larger ones.

Flushing and ventilating not only prevent nuisance but also help to remove disease germs. Ventilation either tends to desiccate them or to scatter them by dilution to points where they are likely to perish. Flushing carries them away to the outfall. A large number of pathogenic bacteria connected with typhoid fever and diarrhoeal diseases are doubtless contained in sewers. Yet careful inquiries made in Europe and here have not resulted in the discovery of a single case of typhoid fever or dysentery which could be directly traced to sewer air where sewers had been kept clean and fresh.

Sewers were first introduced for the purpose of carrying away rain-water. It was only a second thought to carry away also the waste water from the houses through the introduction of the so-called water-carriage system of sewage removal. The method of uniting the sewage and rain-water in the same channel has caused what is known as the combined system of sewerage.

In recent years it has frequently been found more economical to carry the dirty water or sewage away by a separate system of pipes, and the rain-water by another system. An economy results from the fact that in building up town areas we are generally more concerned at first in removing the dirty house water in pipes than the street water, and are willing to let the latter run off on the surface so long as no trouble is caused thereby. When the latter becomes objectionable, then it often happens that much shorter drains are required, because the rain-water is comparatively clean and can be discharged into any near brook, while the sewage must be carried farther away and perhaps must be treated. Sometimes a city has both systems, as, for instance, Philadelphia, where the combined system is used for the largest part, but where in the suburbs there are sections where the separate system has been preferred as being less expensive.

The separate system is generally preferred where the sewage must be treated in some way, and where it must be pumped. Should there be a large amount of rain-water mixed with the sewage, the treatment and the pumping become expensive.

The question has frequently been raised as to whether or not the first flow of the rain-water, which generally carries manure and dust from the streets of a city and a great many bacteria deposited upon the street surface, should be carried into the sewers or kept separate in the storm-water drains. Dr. William Dunbar, of Hamburg, very carefully determined the condition of the street water at the beginning and at the end of a storm. He found that at the beginning the water was as foul as the sewage in the sewers. It is very desirable, therefore, if it can be practically done, that in the case of a separate system the first wash from the streets be taken into the sewers, so that it can be treated with the sewage. This expedient is followed in some cities in Europe, and I think that in the future it will be followed more frequently in our country than heretofore.

Another most important part of a city sewerage system is the final disposal of the sewage. This should be accomplished in a manner so that it will not be harmful nor unpleasant. We should, therefore, soon determine upon a place of final discharge and a method of treatment to which it should be subjected.

Such a treatment may be complex. We have to consider disease germs on account of the danger to health, and the putrefying matter so far as a nuisance is concerned. We have further to distinguish between the most economical ways to prevent both of these troubles.

One part of the sewage is solid matter in suspension, and the other part is liquid matter together with fine suspended matter which will not readily settle out but remains in the liquid and causes it to be more or less turbid.

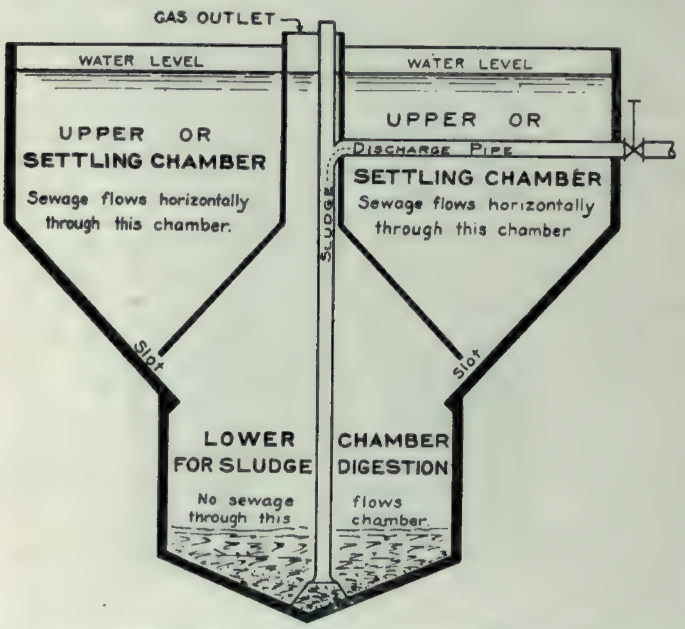
For the purpose of any subsequent treatment it is best to divide the sewage into these two parts, because the treatment of the solids demands an entirely different process from that of the liquids.

The first thing to be done, therefore, when sewage is to receive any treatment, is to allow the suspended matter to be held back and separated from the liquid matter, so far as this is practicable.

The collection of the solid matter is accomplished by screens and by sedimentation. Many sewers, when they discharge into rivers, have screens near their outfalls causing the larger matters to be retained, taken out, and separately disposed of. Sometimes this matter is pressed, squeezing out much of the liquid, and the remaining matter is either buried or burned.

Where screening is not adopted there is no way of keeping out the floating matter, except by retaining the sewage in large basins in which the floating matter gathers at the top and from where it can be removed at the surface. The retention of the sewage also causes the heavier matters to deposit.

When the oxygen in the sewage is exhausted the deposited matter or sludge begins to putrefy, and the evolution of gases causes the entire mass of sewage and sludge to become putrescent or septic and emit strong odors. Many studies have been made and perhaps a hundred patents have been taken out relating to the treatment of this sludge so that the results would be acceptable both from the standpoint of cost and nuisance.



Vertical section through Imhoff tank at right angles to the direction of sewage flow.

The most common treatment has been to put the sludge upon fields, where it was dried, ploughed in, or covered with lime, etc. It has also been pressed, mixed with strong fertilizers or pulverized and used as manure.

In order to have a more complete removal of the suspended matter from the sewage, lime was added to the water. The resultant sludge, increased in quantity, was then usually dumped or pressed into solid cakes, for use as fertilizer.

All the processes of treating sludge were, however, not very satisfactory because of the resulting stenches. Yet they had to be recommended as the best known expedients, and on account of the offensive odor it was necessary to locate the treatment works far away from the inhabited parts of the cities. Only a few years ago the city of Baltimore bought a strip of land about 1,000 feet wide outside of its works in order to obviate any nuisance.

About eight years ago a German engineer erected some experimental plants at Essen, modelled after the experience gained at the sewage fields near Hampton, England, where Dr. Travis had been making some promising studies. The Essen experiments, undertaken by Dr. Imhoff, resulted in the discovery of a means of securing a collection and a treatment of the sewage sludge that was not offensive.

This process is now known as that of the Imhoff tank treatment, varying the process from that used at Hampton, by preventing any circulation in that part of the tank where the sludge is deposited and where it ferments, Dr. Imhoff has succeeded in establishing a decomposition confined to the biological action of such classes of bacteria which develop substantially only marsh gas and carbon dioxide gas, neither of which has an odor.

It is known that if no fresh sewage flows over decomposing sludge, to supply it with miscellaneous sewage bacteria, the controlling bacteria in the sludge are confined substantially to but two classes; namely, those producing the two inoffensive gases just mentioned.

The Imhoff tank consists of practically two tanks, one over the other. Through the upper one the sewage flows with a velocity reduced so much that its suspended matter will settle. It requires a passage through the tank of from 1½ to 2½ hours. This matter is allowed to slip through a slot into a lower chamber in such a way that no possibility exists for any solid matters to rise and again mix with the fresh sewage passing by in the upper tank. There are special shafts provided for the ascent of any fat or light matter, which should rise with gas bubbles from the lower chamber, and to form a scum in the shaft, to be removed when necessary. This scum is usually small in amount and could be readily removed if it becomes excessive. It has no objectionable odor in any of the existing plants.

The accumulating sludge in the lower tank, when it has become ripe and the existing bacteria have been practically exterminated, has no odor. This can be found by extracting some of it from different depths. According to the character of the sewage, it requires about three to five months to be decomposed sufficiently so that it will not become putrescent when again exposed to the air. The decomposed sludge is withdrawn from the bottom of the tank automatically, and, being deprived of its slimy, putrescible matter, it is friable and porous, looking very much like garden soil, to which it is very similar. The latter has been formed from the leaves and branches without putrefaction and with the evolution of the same inoffensive gases, such as marsh gas and carbon dioxide, which produces the decomposition in the Imhoff tanks. It rapidly drains out its superfluous water, and dries in well-drained beds within a week sufficiently to be spaded and removed.

There are over one hundred plants in operation in Germany and this country, and reports indicate that in none of them which are properly operated does the sludge have an offensive odor. In America the largest plant is in Atlanta, Ga., and there is one at Holmesburg, Philadelphia, below the Torresdale Water Filtration Plant.

It is gratifying, therefore, that we have now a means of treating the sludge so that it will not be offensive, and we believe that by the same process the disease germs contained in the sludge will have perished by the time it is extracted and dried.

Before sewage reaches the tanks it is advisable, particularly where the sewage contains street wash, to take out any gravel or sand (i.e., grit). This deposition is secured in a special small chamber where the velocity of the sewage is reduced to about 12 inches in a second. This reduction will cause the grit to deposit and the rest of the suspended matter, which contains the foul matter, to pass on to the settling chambers. In these tanks the velocity is much more reduced, generally to about one-tenth inch per second. This comparatively quiescent state causes the deposition of practically all of the foul suspended matter which forms the bulk of the sludge. We use the term "settleable" matter because there is not deposited the fine suspended matter which may cause putrefaction and which must be treated together with the dissolved organic matter.

In order to increase the quantity of settleable sludge, experience has shown that by adding a precipitant to the sewage a large percentage of this fine matter and even some of the dissolved matter can be coagulated and also settle into the lower tank. In the latter case the effluent sewage is much clearer, but the size of the lower tank must be correspondingly increased on account of the added sludge and precipitant. It is, of course, a question to be determined in each case as to whether or not it is necessary or wise to add a chemical precipitant.

You have all heard of the septic tank. This was first used under this name in the city of Exeter, England, and it was found that in a single basin where the sewage was retained at least eight hours most of the suspended matter was deposited on the bottom and underwent putrefaction. It was allowed to remain in the tank until fairly well rotted out, which generally took at least a year.

This was a process of putrefaction which produced chiefly sulphuretted hydrogen, and, therefore, not only the liquid but also the putrefying sludge sent up bubbles of offensive gas. Notwithstanding this fact, septic tanks have been very extensively used on account of their relative economy as compared to other processes, and it was even heralded as the long-expected final solution of the sludge question. A good deal of the sludge disappeared, so that in a few cases but ten per cent. of the original quantity was left; in most cases the record is from 25 to 50 per cent. The reduction in the quantity of sludge handling was the chief attraction of this process.

On account of the odor septic tanks were isolated and kept far away from inhabited sections of a city. In the city of Saratoga, N.Y., there is a well-devised system of sewers and of sewage treatment, with possibly the best installment of a septic tank in this country. The odor from the tank, however, is very strong. In one of the suburbs of Berlin (namely, Wilmersdorf) septic tanks are also used with similar results. The odor from the tanks was found to be perceptible over a mile away.

We cannot place much reliance on the figures given as to the reduction of the sludge, because so much depends upon the amount of water contained therein. If we have originally 95 per cent. of water in the sludge and reduce the same to 90 per cent. we have diminished the quantity of sludge practically one-half. This fact makes it necessary, when comparing quantities of sludge, to compare also their percentages of water.

The sludge of the septic tank is of a different character from that of the Imhoff tank. It is not as thoroughly decomposed, generally retains a large amount of fine and slimy matter with a large amount of water, and after withdrawal does not become spadeable sometimes for several months.

The last subject to be mentioned is the treatment of the liquids after they have been freed from the settleable suspended matter by passing through the tanks. There are still generally left a substantial amount of fine suspended particles and a large amount of dissolved organic matter. The oxygen contained in the water is rapidly extracted.

If the sewage is discharged into a running stream, and if there is enough oxygen in it to oxidize its organic matter, a decomposition of the organic matter will take place in the water. This method of oxidization in running streams is a practicable and legitimate means of oxidizing liquid sewage. It is just as rational as an oxidation on land. We are, therefore, not justified in seeking the entire exclusion of all sewage from rivers where they can be utilized for oxidation, both economically and without offence.

We must not forget, however, that nuisance is not the only question to be considered. We must prevent also all objection due to the injury of fish and shell fish and to a possible danger from bathing, and in no case can such water, which has received sewage, be used for drinking purposes, unless it is first purified. We must also not forget that river water may be polluted as much from the natural land washings and city washings during a rain storm as from liquid sewage.

Nearly all of the large cities of the world dispose of their sewage by river dilution. In some cases this process is not properly carried out; the solid matter of sewage is admitted in too large proportions, and sludge remains in the rivers by sedimentation. Sometimes, also, more liquid sewage is discharged than can be properly oxidized by the water. Yet, after the floating matter and sludge have been removed, before sewage is discharged into a river, and if the river contains enough oxygen, there can be no objection to utilizing nature's means of purifying organic waste matter in this very economical way.

If there is no river, or if the river is not large enough to promptly dilute the amount of sewage in question, and if there is trouble anticipated regarding fish life, then it is necessary to purify some and often all of the sewage on land.

There are many processes of such purification on land which have been tried, particularly in England. It will not be necessary to mention them all, because most of them have been abandoned. To-day there are really but two processes in use: a treatment by coarse-grained filters and a treatment by sand filtration.

The coarse-grained filters are built of material from the size of a walnut to the size of a fist, and of depths varying from 5 to 10 feet. The sewage is delivered upon the top in various ways. In all cases it must be sprinkled either from stationary or moveable jets, because otherwise the large pores of the bed would let it rapidly run through. The sewage percolates through the bed by slowly flowing on the surfaces of the grains from one to the other until it reaches the bottom. Upon these grains or stones is a slimy coating which harbors myriads of bacteria. These take from the passing sewage the organic matter which is in solution and convert it into inoffensive and inert matter. While the water may be quite putrescible when sprinkled on, it leaves the filter, if this is properly devised, without putrescibility, i.e., in a condition so that it will not become foul.

The process of sand filtration is virtually the same as just described. The grains are much smaller and, therefore, the liquid can flow directly upon the bed for distribution instead of being sprinkled. The speed of percolation is much slower and, therefore, the purification is greater. Bacteria do the converting in both cases.

Both coarse and fine-grained beds are underdrained to allow of a free discharge of the effluent, and both should have a free circulation of air between the grains to supply the oxygen which is necessary to convert organic matter.

Costs and Methods of Building Large Sewers*

By H. R. Abbott†

PRACTICALLY all of the work described in this paper—which deals with construction methods and costs for large concrete and brick sewers—is built in good stiff blue clay, in the Sanitary District of Chicago. The improvements are all of recent date—some are still unfinished—and include 12 x 14-ft. plain and reinforced concrete sections on West Thirty-ninth Street, 7-ft. and 7½-ft. brick sewers and reinforced concrete conduits as large as 16 ft. in greatest dimension, on South Fifty-second Street. The total length of the sections described is about 17,600 ft.—10,000 ft. in brick, 5,320 ft. in plain concrete and 2,280 ft. in reinforced concrete. The latter part of the article is devoted to a discussion of cost-keeping methods. All the tables given cover field operations only, but overhead charges are discussed in the concluding portion of the paper.

West Thirty-ninth Street Conduit

One conduit, 12 x 14 ft. in size, of elliptical section, was built in West Thirty-ninth Street, from Western Avenue to Robey Street; thence south to the west arm of the south fork of the Chicago River. The total length is 2,346 ft., of which 1,868 ft. are plain concrete and 478 ft. reinforced concrete, the reinforced section being under railroad property. Connection was made at Western Avenue with a conduit of similar section, extending north in Western Avenue to the main channel of the Sanitary District. The conduit was designed to discharge from 100 to 200 cu. ft. per second. It has a 1:1,000 grade, and the flow line is about 3 ft. below crown.

Excavation was started at the Western Avenue end in open cut. A Bucyrus 70-ton steam shovel, with a 1¾-cu. yd. dipper, was mounted on five 16 x 18-in. timbers, 30 ft. long, with two 2-in. truss rods to each timber. The trench width was 15 ft. 8 ins. and the average cut 23 ft. 6 ins., making an excavation of 13.7 cu. yd. per running foot. On account of the deep cut, the shovel was equipped with a 36-ft. boom and a 54-ft. dipper handle. As there was liability of slides and cave-ins, the excavation was handled in two lifts. On first run the shovel excavated the top 10 ft., using 9-ft. sheeting with one set of bracing placed about 6 ft. below the ground surface. The shovel dug ahead of the finished cut from 75 to 100 ft., then backed up and excavated the lower 13½ ft. The lower lift was taken out between steel beams, each built up of two 10-in. I-beams with cover plates, 50 ft. long, held in place by screwbraces set 7 ft. back from each end. This replaces the ordinary wooden bracing and allows a free movement of dipper in the trench for three moves. When a section is finished, the beams are carried ahead by the dipper, the wooden braces are replaced on the top sheeting, and another set of 9-ft. sheeting is placed with two sets of braces for the lower portion of the trench, the lower end of sheeting being at a point where the invert curve meets the side wall.

The average progress on the plain concrete section per day of nine hours was 30 ft. for both shovel and mixer. This means 420 cu. yd. of excavation, with disposal in backfill or spoil bank. The actual costs of excavation, backfill and spoiling for plain and reinforced sections are given in Tables 1 and 2. The concrete averaged 2½ cu. yd. per linear foot—a daily average of 75 cu. yd. The average progress per day on the reinforced section was 24 ft.

A three-ring brick sewer in South Fifty-second Avenue, Cicero, extends from Ogden ditch to Twenty-second Street, a total length of 10,000 ft., of which 7,300 ft. were 7½ ft. and 2,700 ft. 7 ft. in diameter. With the exception of 1,050 ft. of the 7½-ft. section, which was in tunnel, the entire conduit was built on the line of an old 4 x 5-ft. wooden box sewer. The sewage flow was usually held back for periods of eight to sixteen hours, depending on rainfall, by a temporary gate, consisting of a 3 x 3 x 12-ft. inclosed box, having a sliding door working vertically about 4 ft. from the upstream end. The old wooden box sewer was first uncovered at a point 600 to 1,000 ft. ahead of the steam shovel. After the top was removed, the gate was lowered into the old box and packed in place with sand bags. The gate was operated by a lever at the ground level by a night watchman, who generally closed the gate at 6 a.m. and opened it at 7 or 8 p.m. A 45-ton Bucyrus steam shovel equipped with a 1¼-cu. yd. dipper, excavated the trench, placing the excavated material alongside. The average cut was 21 ft., made in a single cut. The existing box sewer was ripped out by the shovel as the trench advanced.

During the progress of the work, several severe rainstorms occurred, causing considerable delay and some damage. In a portion of the work where sheeting had been pulled, a severe rain caused the bank to slide, which, together with the added weight of the spoil bank, caused the collapse of 130 lin. ft. of completed sewer. The U. S. Weather Bureau record showed a precipitation of 1.57 in. for two hours. The cost of repairs for this 130 ft. was $11.46 per foot, or 94 per cent. of first cost. On account of storms and the softening of the bank by storms and ground water, shorter lengths collapsed. Because of the nearness to building foundations, thereafter sheeting and one set of braces were left in place at an additional cost of 90 cents per linear foot.

Utica cement was used, proving satisfactory in standing up under the night flow of water over new work. A small amount of pointing-up proved necessary in a number of cases where water was passed over the brickwork as soon as laid, and in a special case, when the breaking of the gate had flooded out the bricklayers before the invert could be laid complete. All material was teamed to the work, the average haul being ¾ mile.

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* From a paper presented at the Annual Meeting of the Illinois Society of Engineers and Surveyors. Abstracted by the Engineering Record.

† Assistant Engineer Sanitary District of Chicago.

The average progress per day on the 7-ft. section was 45 lin. ft., equivalent to 330 cu. yd. of excavation, while on the 7½-ft. section the average progress was 70 ft. per day with 20 ft. cut, or 500 cu. yd. of excavation. The difference in the progress between these two sections was partly due to the fact that the 7½-ft. sewer was built in a street 80 ft. wide, with open prairie on one side and unlimited room for work, and the 7-ft. section was built in a 66-ft. street with scant open space adjacent.

The average number of brick laid per day per bricklayer was 4,900 in the 7-ft. section and 5,900 in the 7½-ft. section. Backfilling was done with a Monighan revolving derrick, equipped with a Page 1-cu. yd. orange-peel bucket. This is a very efficient machine for backfilling, but the operator should avoid dropping the load from any distance, as it is liable to crack the masonry, especially during wet weather, when the backfill is saturated with water.

At the Illinois Central Railroad tracks excavation was made by hand and the spoil loaded into wheelbarrows and wheeled to the edge of the right-of-way, at which point it was handled by the orange-peel derrick. The piling and timbering of the tracks was done by the railroad company at its own expense. The hand excavation cost $1.25 per cubic yard.

In another case the steam shovel could not take out the bottom on account of the proximity of a viaduct. This earth was scaffolded out at a cost of $1.06 per cubic yard, being handled four times before it reached the spoil bank.

The moving of the steam shovel a distance of 1,050 ft. across a railroad yard and over the tunnel section cost $560, or 53 cents per linear foot. This includes the partial dismantling of the shovel to pass under obstructions. At the start the shovel was taken off the railroad spur, moved ½ mile and placed on timbers to span the trench, at a cost of $750.

Unit costs for the 7-ft. and 7½-ft. sections are given in Tables 3 and 4.

Tunnel Section

The tunnel section, 1,050 ft. long, extends under the Morton Park yard of the Chicago, Burlington & Quincy Railroad, and passes directly under five piers of the viaduct carrying South Fifty-second Avenue over the railroad yard. In places there was only 12 ft. of covering over the roof of the tunnel. The ground was stiff blue clay, containing but one sand pocket, which caused some earth settlement, visible at the ground surface. There were no settlements whatever at the piers.

The work was carried on by two night shifts of miners and muckers and a day shift of bricklayers, working eight hours each. One shaft was sunk, from which two headings were run. In one of the accompanying drawings is shown the method of timbering in good stiff clay. In poor ground the crutches were made longer, with the lower end set below the spring line, and the 2 x 10-in. planks at the roof were placed closer together. The excavated material was dumped

TABLE 1—COSTS FOR PLAIN CONCRETE 12 x 14-FT. SEWER; AVERAGE CUT 23 FT. 6 IN.

Cost per lin. ft.		Item		Cost per cu. yd.
	$2.53 Labor	Excavation	Labor $0.188	
	.64 Plant		Plant .046	
$3.17				$0.234
0.86		Backfill		0.143
0.89		Waste disposal		0.120
0.75		Miscellaneous		.....
1.21		Coal		.....
0.99		Lumber		.....
10.42		Concrete masonry:		
		Labor		1.315
		Cement		1.055
		Sand		0.576
		Gravel		1.103
		Plant		0.804
		Total		$4.133
$18.29		Material and plant	54%	
		Labor	46%	

TABLE 2—COSTS FOR REINFORCED-CONCRETE 12 x 14-FT. SEWER; AVERAGE CUT, 22 FT.

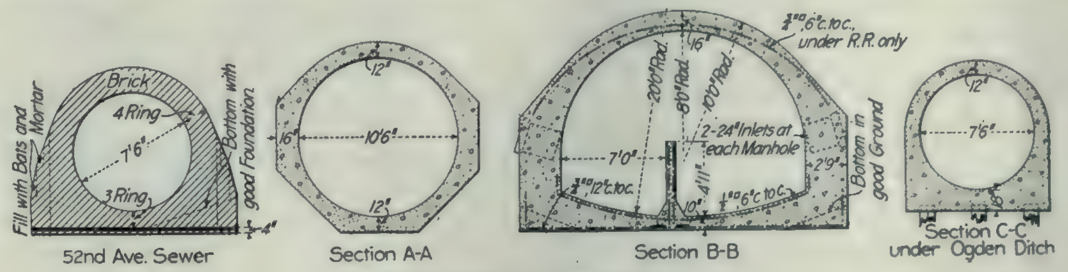
Cost per lin. ft.		Item		Cost per cu. yd.
	$2.43 Labor	Excavation	Labor $0.194	
	.64 Plant		Plant .046	
$3.07				$0.240
1.24	Labor	Back fill...	Labor 0.249	
	Plant		Plant .021	
				0.270
0.31		Waste disposal		0.041
2.26		Miscellaneous		.....
1.21		Coal		.....
0.99		Lumber		.....
14.85		Concrete masonry:		
		Labor		1.975
		Cement		1.055
		Sand		0.576
		Gravel		1.103
		Reinforcing steel		1.103
		Plant		0.084
		Total		$5.896
$23.93		Material and plant	52%	
		Labor	48%	

TABLE 3—COSTS FOR 7-FT. BRICK SEWER; AVERAGE CUT, 21 FT.

Cost per lin. ft.		Item		Cost per cu. yd.
	$2.22 Labor	Excavation	Labor $0.308	
	.28 Plant		Plant .040	
$2.50				$0.348
	0.81 Labor	Back fill...	Labor 0.226	
	.14 Plant		Plant .038	
0.95				0.264
1.00		Waste disposal		0.544
0.19		Pumping		.....
0.62		Miscellaneous		.....
0.35		Coal		.....
1.12		Lumber		.....
7.60		Brick masonry:		
		Labor		2.63
		Teaming		.49
		Brick		4.08
		Cement		.57
		Sand		.29
		Total		$8.06
$14.33		Material and plant	49%	
		Labor	51%	

TABLE 4—COSTS FOR 7½-FT. BRICK SEWER; AVERAGE CUT, 20 FT.

Cost per lin. ft.		Item		Cost per cu. yd.
	$1.63 Labor	Excavation	Labor $0.226	
	.28 Plant		Plant .040	
$1.91				$0.266
	0.43 Labor	Back fill...	Labor 0.119	
	.14 Plant		Plant .038	
0.57				0.157
0.41		Waste disposal		0.417
0.15		Pumping		.....
0.81		Miscellaneous		.....
0.35		Coal		.....
0.47		Lumber		.....
7.50		Brick masonry		
		Labor		2.10
		Teaming		0.30
		Brick		4.08
		Cement		0.57
		Sand		0.29
		Total		$7.34
$12.17		Material and plant	53%	
		Labor	47%	


Fill with Bats and Mortar
Brick
4 Ring
7'6"
3 Ring
Bottom with good Foundation
4"
12"
16"
10'6"
12"
$\frac{3}{4}$" ⌀, 6" c. to c., under R.R. only
16"
20'0" Rad.
8'0" Rad.
10'0" Rad.
2-24" Inlets at each Manhole
7'0"
2'9"
$\frac{3}{4}$" ⌀, 12" c. to c.
4'11"
10"
$\frac{1}{2}$" ⌀, 6" c. to c.
Bottom in good Ground
12"
7'6"

52nd Ave. Sewer
Section A-A
Section B-B
Section C-C under Ogden Ditch

Sections of brick and concrete sewers.

from the shaft into railroad cars and hauled 3 miles to Western Avenue.

The method of setting up the centres for the arch after the invert is built and timbering removed is shown in one of the drawings.

In each heading the average progress for twenty-four hours was 12½ ft. The average number of brick laid per eight hours per bricklayer was 3,000.

Table 5 gives unit costs for the work in the tunnel section.

Work on the South Fifty-second Avenue sewer outlet, in the Sanitary District section, is now under contract. The main section consists of a 12 x 16-ft. horseshoe-shaped sewer, the outfall being at the main channel of the Sanitary District at South Fifty-second Avenue. This section extends north 1,800 ft. from the canal to a point where it will divide into two sewers—10 ft. 6 ins. and 9 ft. The 10-ft. 6-in. section extends westward to Fifty-sixth Avenue, where it will connect with the 8-ft. 6-in. Oak Park sewer and the Berwyn 5-ft. sewer, both of which now discharge into Ogden ditch. The 9-ft. sewer will extend north across the Ogden ditch and connect with the 7-ft. 6-in. Cicero sewer. This section has a grade of 1 in 5,000, the grade being largely fixed by the elevations of the outlets of existing sewers. The dividing wall was designed to keep high velocities in dry weather and avoid deposits. At the upper end of the 16-ft. sewer stop planks are arranged, to divert the dry-weather flow to either side of the dividing wall.

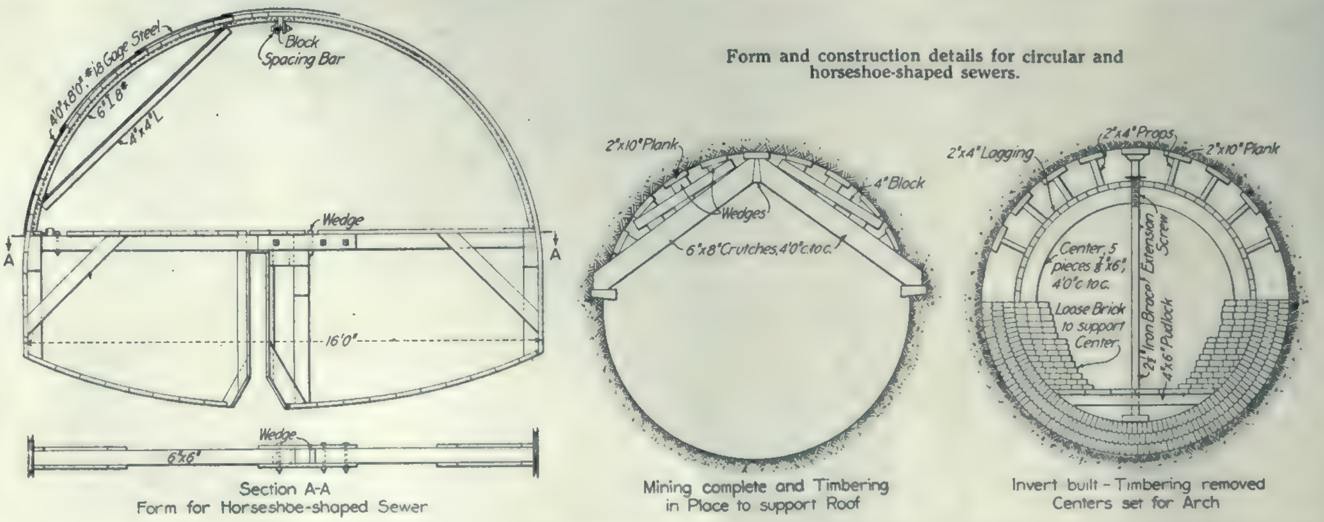
It was necessary to excavate through the spoil-bank of the Sanitary District main channel before the sewer trench could be started. The equipment comprises a 45-ton Bucyrus shovel with a 1¼-cu. yd. dipper mounted on 36-ft. timbers to span the trench. The average cut is now 17 ft., with a width of trench of 21 ft. 10 ins. Excavated material is loaded into 4 cu. yd. cars and deposited in backfill and the excess hauled about ¼ mile.

The entire work is to be built of 1:2½:5 concrete, except the dividing wall, where it is approximately 1:2:4. The order of pouring is as follows: invert, sides and arch. The invert and dividing wall in the 16-ft. section are reinforced with steel throughout, as is the arch for about 100 ft. where the sewer passes under the C. & I. W. Ry. The reinforcing is designed to take care of any unequal settlement due to soft ground.

Below the spring line the side forms are built of 1-in. flooring, nailed to 6 x 6-in. uprights, 4 ft. on centres, braced by a 6 x 6-in. cross timber at the spring line, supported by a 6 x 6-in. post near the centre of the sewer, with diagonals extending to the vertical posts. Above the spring line, 6-in. 8-lb. channels are used, curved to the proper radius, and reinforced with a 4 x 4-in. angle, 8 ft. long at the quarters. On the ribs, which are spaced 4 ft. on centres, is placed 2 x 6-in. lagging, on which sheets of No. 18-gage sheet steel is laid, lapping about 6 ins. For the dividing wall the form is built up of wooden sheets 8 ft. long, suitably braced against the side walls, with steel separators between to maintain the proper spacing.

Contract prices per linear foot for the work are about as follows: 16-ft. sections in 17-ft. cut, $40.63; 10½-ft. section in 12-ft. cut, $15.48; 9-ft. section in 14-ft. cut, $12.83.

For the use of the sanitary division of the district,



Form and construction details for circular and horseshoe-shaped sewers.

Section A-A
Form for Horseshoe-shaped Sewer

Mining complete and Timbering in Place to support Roof

Invert built - Timbering removed
Centers set for Arch

a daily report was devised, for labor and progress of the work, designed to fit either a brick or concrete job. The distribution of hours is made at the time the form is filled in. The rate per hour need not be filled in daily, since this can be covered on one sheet showing the rates for the entire job. From these reports a monthly tabulation is made, the rate per hour applied, and extensions made reducing the whole to a money basis. At the end of the job, the monthly statements are compiled, making one tabulation for the entire job. The weekly reports for material can be handled in the same way.

A daily report for material was also devised, showing the amount of cement in the warehouse, the amount used in the work, and the yardage of concrete placed. The tally on cement is kept by the inspector at the mixer as the bags are delivered. The inspector can also fill in the station numbers showing progress. The number of cubic yards placed can be entered by the engineer-in-charge. A small table showing the number of cubic yards per running foot of invert, sides and arch, is a very handy thing so that quantities can be entered without any extended computation.

The item of plant charge is a difficult one. For instance, there are steam shovels in service to-day that are twenty-five years old, whereas others are worth only scrap value at the end of three or four years. Many contractors charge off the entire plant to the job. So far as I see, for machinery such as steam shovels and dinkeys, it is fair to spread the plant cost over a period of ten years, allowing interest at 6 per cent. on first cost, thus making a depreciation charge of 16 per cent. per year. Alterations, fitting up, freight, small tools, etc., are directly chargeable against the job, and should be added.

TABLE 5—COSTS FOR 7½-FT. BRICK SEWER, IN TUNNEL

Cost per lin. ft.	Item		Cost per cu. yd.
$6.49	Excavation		$2.43
2.05	Waste disposal		0.77
.40	Lumber		
.15	Power		
1.26	Miscellaneous		
9.35	Brick masonry:		
	Labor		4.40
	Brick		4.09
	Cement		0.57
	Sand		0.29
			$9.35
$19.70	Material and plant	27%	
	Labor	73%	

In considering the overhead charge to be made, some figure must be taken in making up an estimate. This is more apt to be too small than too large. In Illinois liability insurance will cost from 7½ to 11 per cent. of the payroll, and on work described in this paper the labor item is about 50 per cent. of the total field cost for open cut work, and 70 per cent. for tunnel work. This makes a charge of 3½ to 8 per cent. for insurance. Office rent, telephone, cost of getting work, and other items may increase this to 10 or 15 per cent. Adding 15 per cent. for profit, we thus have 25 to 30 per cent. to add to the field cost. With the aid of the data contained in the tables, reinforced by current market quotations on material, the author has made estimates for similar kinds of sewer work, in the aggregate about one-half million dollars. Such estimates agree with the low bid within 4½ to 7 per cent. In transferring the unit costs for work already performed to new estimates, due consideration must be made for differences in the local conditions, character of the soil, any increase in cost of labor, and the availability of standard types of machine to handle the work.

Municipal work at the city of Victoria, B.C., is by no means cast down. The City Engineer, Mr. C. H. Rust, advises us that the north-west sewer is now under construction at an estimated cost of $365,000. The work will be completed in 1915. Roadway and sidewalk work has been comparatively active this season and operations are expected to continue for another month. A large programme of paving work has been mapped out for next season, the total expenditure contemplated being between $400,000 and $500,000. The Sooke Lake scheme is progressing satisfactorily and it is hoped to have the pressure pipe line completed in January. The total length will be about twelve miles. The contractors for the concrete flow-line have laid eight miles out of twenty-seven. This work, it is expected, will be completed about next August. So far, the city has experienced no trouble in arranging for money, as most of the money was on hand for the work now under construction before the war started. Satisfactory arrangements have been made by the Council for the funds necessary to the completion of the Sooke Lake contract.

The bag house at Palmerton, Pa., for the New Jersey Zinc Company, has an 1,800-ton, 64½ x 805-ft. structural steel framework, 59 ft. high to the lower chords of the roof trusses. It is of regular simple construction, with tall spliced columns and light rivetted roof trusses, and has a large number of duplicate panels. The framework contains 162,440 pieces, handled separately in the field, none of them weighing more than 4,000 lb. The heaviest ones were assembled by a Bay City 25-ton long-boom locomotive crane which moved from end to end of the building on a longitudinal track, receding from the last finished bent. A considerable proportion of the lighter pieces were erected by hand without the use of the crane. The work involved driving 127,398 steel rivets and placing 70,793 permanent connection bolts and was executed by the Pittsburgh Construction Company.

Dynamite inserted in lengths of condemned fire hose was used to cut to pieces the steel drill barge Teredo, which had been sunk at Panama by an accidental explosion. It having been found impracticable to raise it, it was decided to cut it to pieces. The hose with its charge of explosives was placed along the line at which it was desired to direct the force of the blast and made a fairly clean cut. The sections sheared off were raised by wrecking barges assisted by a dipper dredge.

The American Society of Municipal Improvements will hold their Annual Convention at Boston, October 21-23. Mr. H. E. Mann, Chief Engineer, Montreal Light, Heat & Power Company, was elected President of the American Gas Association at the 7th Annual Convention of that body held recently in Ottawa.

From Ottawa comes news of the death by drowning of Jas. Wilson, a government engineer on the Hudson's Bay Railway. Mr. Wilson was a victim of a canoe accident in the Shell Rapids, in the Nelson river.

28 (41) 1914

Speculations on the Problem of Housing the Working Classes in Vancouver

Contributed by R. McKay Fripp, F.S.A., Vancouver

THE object of all reform in housing is to provide fresh air within. This seemingly simple proposition is one of the most difficult problems which the larger modern city has to solve. In the first place, to have fresh air within, it is necessary to have fresh air without. This means ample open space, the most difficult and costly thing to secure when by bad town planning it has been lost. The first result of this loss is the slum, with all its attendant evils—overcrowding, discomfort, inconvenience, decreased health, physical and moral degeneration, increased criminal population, more police, more jails, more jailbirds. All these evils multiply like bacilli in a cess-pit and constantly spill over and spread contagion. Slums are indeed very poisonous and dangerous sores on the body politic. In old cities a slum is a regrettable incident difficult to remedy, for although the decayed district may be removed, the inhabitants of the warren cannot be eradicated; the rookery removed the rooks simply fly elsewhere.

But what is a regrettable incident in an old city becomes a disgrace in a new one. When those plague-spots appear in a new city of very moderate size, surrounded by a vast area of practically unoccupied country, it is obvious that they could have resulted only from very bad town planning, gross negligence or equally gross ignorance or apathy on the part of the civic authorities. But the important question now is not how the conditions arose but how they may be removed and their recurrence prevented.

This problem of Housing Reform is beginning to engage the attention of every progressive city north of the Mexican boundary. Not the housing of the rich or the moderately well-to-do. This part of the problem generally finds its own solution; for except in the somewhat unique instance of Vancouver, new developments in medium-class residential districts are planned so as to ensure ample space for air and sunshine, for the disposal of residential buildings with due regard to aspect and prospect, for the creation of lawns, gardens, shrubbery and trees. In brief, it is rapidly becoming the custom to plan and design where heretofore the sole object has been to make the greatest possible number of the smallest possible lots absolutely without regard to the other considerations.

Public health is a purchasable commodity. It can be bought, and the price that is paid for it includes fresh air, sunshine, parks, recreation-grounds, playing-spaces for the children, gardens, trees, grass, flowers—all for the public—and fresh air, sunshine and cleanliness within the home.

The chief cause of tuberculosis is, as every one knows, the absence of, or insufficiency of, two of the cheapest things on earth—fresh air and sunshine. The remedy is an ample supply of fresh air and sunshine, and the preventive measure is the continued assurance of that ample supply of Nature's cheapest provision, by the provision of open spaces, not only in the form of parks and playgrounds, but by the disposition of the mass of poorer homes in such manner as to ensure free action of air and secure the maximum of sunshine. Not only does it pay a city, from the hygienic viewpoint, to provide ample public open spaces, but it is the greatest influence for good in other ways, for it has been demonstrated over and over again that of the children and younger criminals who fill our reformatories, 80 per cent. are recruits from the gutter and the overcrowded districts. All public parks or open spaces are fine investments from the real estate point of view. They increase in value; other public works depreciate. They not only pay for themselves, they also create new real estate values in their vicinity. They are therefore money-makers as well as money-savers; they make for good citizens instead of human derelicts and good human assets as opposed to human wastage—the worst and most deplorable form of wastage. This is all so well known, so frankly acknowledged, that it is the more extraordinary that civic bodies do not render overcrowding absolutely impossible. As a matter of fact the civic authority invariably is the great stumbling-block, the bar most difficult to remove from the road to progress. The perennial excuse is either the absence of enabling powers in the city charter, or the want of funds. Either is so invalid that when used it may be concluded that the proposed reform or development is opposed. The obsolete system of representation by wards is frequently responsible for this opposition.

Vancouver's Growing Population

The population of Vancouver is well over 100,000—not a very large figure, but there is no doubt that after the war and the return of normal conditions there will be a steady, and possibly a rapid, increase. With this increase will inevitably arise the problem of housing near their points of employment an ever-growing body of workers. At the present time there is no attempt to deal with the question: the working classes shift for themselves. Quite a fair proportion have or are proceeding to acquire their own houses. Without any figures to guide me I am led to believe from observations of my own that the great majority of those owning their own homes are artisans, carpenters, stone masons, bricklayers and so forth, earners of high wages, ranging from $3.50 to as much as $6.00 a day. Very few indeed of these live within easy walking distance of their work, most of them being driven by the high price of land to seek lots more within their financial scope in comparatively outlying districts; but the proportion of the working population in any large and growing city which can or do become "owners" is always small and does not materially affect the question of providing suitable, i.e., healthy, convenient, cheap housing for thousands of wage-earners. It must be borne in mind that the item of rent goes far to determine the scale of living.

The wage-earners are, broadly speaking, divisible into four classes—those whose earning capacity is below the normal, unskilled labor of the minimum standard rent-paying capacity; more highly paid unskilled labor, and highly paid skilled labor. It is members of the first class that sink most easily to the level of the slum dweller and this class affords the most serious economic proposition, for it is unable to pay a rent based even upon the lowest standard of decent housing. It is a class ever present in every city and evinces always a strong tendency to increase. The average earning capacity is difficult to arrive at, but assuming the maximum at $10 a week as being probably sufficiently near the mark, what description of accommodation can be provided at the highest rent that can be squeezed from such earnings?

It is necessary to fix some standard of housing before fixing standard rents, and to do this a great deal of preliminary calculation has to be made, and other standards not exactly "fixed" (which is good only in the case of irreducible minimums), but approximated and made adjustable to local conditions.

The tenement-house is but a slightly mitigated evil and is regarded as such by all modern students of housing reform. It is impossible, in a short article, to deal in detail with the reasons that have lead to this conclusion: all I can do is to state the main facts. The 4, 3, 2 and 1-family homes are admittedly the best forms of housing. In 4 and 3-family homes the building may assume externally the appearance of a single house. In no case, even when the one-family home is built in rows, need the result be wholly monotonous, unattractive or wanting in individuality, but this is exceeding my limits. The lowest standard of efficient home consists of a living room, kitchen, a small scullery for washing, fuel, etc., and one bedroom for two adults and one infant, a toilet and bath, additional bedrooms for each additional two, or at most three, children. The sizes of the rooms vary slightly, averaging 150 square feet for living room-kitchen, 80 square feet for scullery, 140 square feet for each bedroom or a total area of 550 square feet when walls, bathroom and chimney are allowed for.

The most economical, decent method of arranging these "lowest standard" homes within fire limits is that adopted by the London County Council. A certain area of land is purchased and surrounded by the buildings in such a manner as to leave an interior court of considerable dimensions—large enough to provide a community playground with seats, trees, grass and space for drying the wash. These grounds are not for the children only: they serve for the women also, and as social meeting-places for the men and women after work. The rents are as low as 60c. a week, or about one-eighth of the weekly wages. Small as this return is, it is said to be an economical rent—that is, the return upon the whole investment covers the interest and charges. It would seem that here we have a satisfactory solution of this section of the housing problem, especially when the municipalities in England pay nearly as high an interest on the money borrowed as our own municipal borrowers; indeed, it is probable that the rate of interest is higher when the rate of wages is taken into consideration. This being so, why should there be the slightest danger of slum areas arising in Vancouver? Yet the danger does exist where there is over-crowding with all its attendant evils. Apparently, then, it is obvious that all the civic authorities need do is proceed to condemn and purchase a few blocks conveniently situated and erect a sufficient number of the type of dwelling proved to be most necessary, raising the funds by a 4 per cent. or 4½ per cent. loan. But when one reduces the proposition to dollars and cents the figures are disconcerting. The average "block" contains 20 lots, 25 ft. x 120 ft., a 20-ft. lane and a parallel row of twenty lots, which gives a total area of 500 ft. x 260 ft., the obsolete "lane" or "alley" being closed. Upon this, in the form of a hollow oblong, seventy-two lower standard homes can be erected, each containing 11 ft. x 15 ft. 6 in. living room-kitchen, small pantry, 8 ft. x 9 ft. scullery with sink, washtub and bath, and a 3 ft. x 8 ft. fuel and tool shed, and three bedrooms in the upper half-storey, respectively 12 ft. 6 in. x 8 ft., 11 ft. x 8 ft. 4 in. and 7 ft. x 8 ft. 3 in. These sizes are of course variable. Each house has its own front door and small porch, a few feet of front garden, say 8 ft. 6 in., plus over-all depth of house, 20 ft. 6 in., and 36 ft. for back yard, giving a total of 65 ft. Double this for the parallel row, 130 ft., leaving 130 ft. x 370 ft. for the community playgrounds, not including a garden entrance at each end 51 ft. x 65 ft. The actual open space from back wall to back wall would be 192 ft. width by 442 ft. in length—surely a most desirable arrangement.

The Question of Cost

Now as to cost. Forty lots in all, four of which are corners and valued at probably 50 per cent. more than inside lots, are estimated to cost $45,000, and this is considered a minimum. The houses, if erected with concrete exterior and dividing walls, and rough cast on the outside, roofed with slates, would probably cost $1,000 each if erected all at once. The cube taken is 20 ft. 6 in. x 16 ft. 6 in. floor area. Allow 2 ft. for floors and foundation, 8 ft. height of lower storey and 8 ft. 6 in. to upper surface of ceiling joists in half-storey—that is 20 ft. 6 in. x 16 ft. 6 in. x 18 ft. 6 in., equal to 6,257 cubic feet, which priced at 16c. is $1,001. The pro rata ground value is 1-72 of $45,000, or $625. The cost of each house and land then is $1,626, to which must be added not less than $124 for clearing, preparing the gardens, sewer and water connections, fees and incidental costs—$1,750, a grand total for seventy-two houses of $126,000. This sum borrowed at 4½ per cent. involves for annual interest alone a sum of $5,670, to which must be added cost of repairs, loss by vacant houses, cost of collecting rents, and insurance. The first two items can only be estimated.

These houses being built for the specific purpose of relieving or preventing congestion, and for occupation by the class least capable of paying a normal rental, they must be considered only from this point of view. What rent can be paid by this class? The usual proportion of rent to wages is from one-tenth to not exceeding one-eighth. The probable maximum average earning capacity of this class is stated variously at from $8 to $12, or a rent-paying maximum of $1 to $1.50 per week, an average of $65 per annum, leaving a deficit of $13.75 interest on the first cost of each house and land, or $990 on the block. Add to this amount the loss of rent by vacancy, inability to pay rent from various causes, insurance, repairs, collections, and sinking fund, and this deficit rolls up to formidable proportions.

The estimated cost of the building cannot be reduced; it might even be enhanced. The estimated cost of land within easy walking distance of the points where the sub-normal earning class finds employment cannot be reduced, and cheaper land can only be secured at points so far removed from the place of employment that car-fare amounting to a disproportionate increase of rent would have to be paid by a class of tenants frequently more or less in arears. To raise the rental is to defeat the object. It appears, then, that the housing of the sub-normal wage-earner can only be met in a satisfactory manner at a loss. But when all the advantages of meeting the problem by housing at a certain cost to the city are considered and added to the credit side, there is an immense gain to the community.

Let us suppose that in Vancouver there are 2,500 sub-normal wage-earners, including their children and aged dependents, allowing an average of six persons to each of the houses described, 432 souls would be accommodated in decency and comfort and amidst surroundings calculated to great sociological improvement. Six such blocks would house the 2,500. Estimating the annual loss in each block at $2,000, this will represent the cost at which the slum is prevented and the standard of living, health and morality raised to normal. As the young grow up under favorable conditions there is an ever-decreasing tendency to the jail and the reformatory. Even if the price is underestimated, is it—can it be, too high?

The second class of wage-earners should be housed without loss in the same manner, to the huge benefit of the class. The third class of earners being usually in steady employment should be provided for with due consideration to their needs, such as the addition of a good living-room, as distinct from the kitchen and rather larger bedrooms. There are endless models to guide and instruct, and possibly a basement may be added. The fourth class, skilled wage-earners, should also be treated in a generous spirit. There should be no effort made by the city to make a profit out of them. The rents should be sufficient to cover all expenses and provide a sinking fund and no more, and if the housing is planned and carried out on a sound business basis, the rent will be low enough to appeal to the section of the public it is intended to attract.

A volume might be written on Environment and Efficiency. An ill-planned city provides an environment that may be positively injurious and render complete efficiency impossible, interfering with the relationship of Transit and Housing. In spite of all the talk about City Planning, and the fact that existing defects are due to the absence of skilful planning, these same defects are constantly repeated, extended and perpetuated. Civic bodies having discovered that the remedy of old blunders is expensive, seem to think (if they do think—which I do not venture to assert) that it might also be expensive to avoid the repetition of blunder. The silly rectangular plan has become a habit.

Canadian Pacific Deck Plate Girder Spans

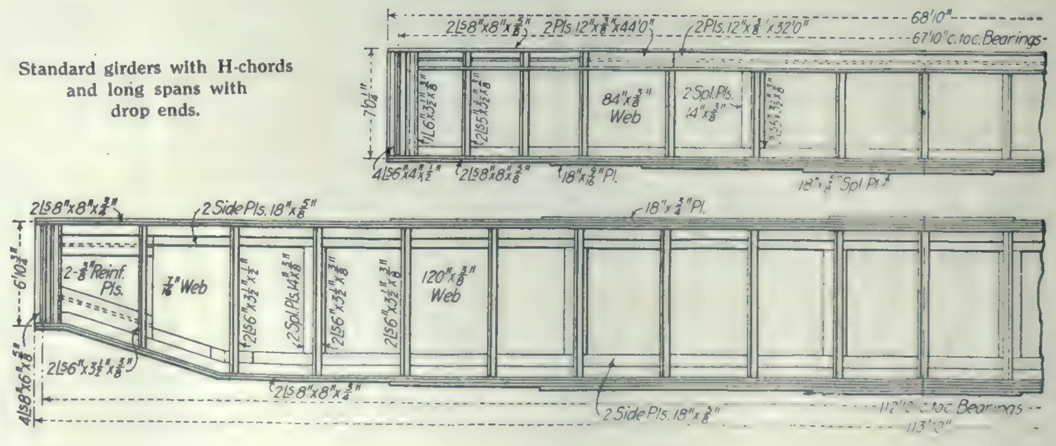
Loads, Stresses and Dimensions of Typical Single-Track Viaduct Deck Spans Measuring in Length 114 and 70 Feet

At the end of the fiscal year, ending June 30, 1913, there were in existence on the Canadian Pacific Railway 4,267 bridges and open culverts. These had an aggregate length of 440,237 ft. (85.7 miles). There were 29,704 culverts other than open, of which 16,866 were permanent and 12,838 temporary. During the year 397 old bridges and open culverts were replaced, aggregating 37,063.5 lin. ft.; 1,070 culverts, other than open, and overhead bridges were replaced; 195 new bridges aggregating 25,388.3 lin. ft. were added during the year. The number of temporary bridges has been reduced during the year by 165, aggregating 10,088 lin. ft. (1.9 miles), and new turn-tables have been fabricated, ten 70 ft., one 80 ft., and one 100 ft. in diameter. The accompanying plans show typical features of long single-track deck plate girder spans used in the bridges.

Span of 114 Feet

Bridge 880 over the Trent River is a plate-girder viaduct 1,493 ft. long and about 50 ft. high from low water to base of rail. It contains one span of 114 ft. over the deepest part of the channel and the remainder of the structure is chiefly composed of 30 and 45-ft. towers and tower spans connected by 75-ft. spans except in a few cases of spans of from 45 to 69 ft.

The design, conforming to the standard railway specifications for 1908, provides for two 177.5-ton locomotives equal to Cooper's E50. For the span of 113 ft. 10 in. (nominally 114 ft.) this live load produces a total moment of 10,865,800 ft.-lb., requiring a flange area of 70.5 sq. in. The maximum shear of 428,500 lb. is resisted by an 84 x 7/16-in. reinforced web plate at the end and by a 120 x ⅜-in. web plate in the center. The maximum flange area of 71.9 sq. in. net is made up of two 8 x 8 x ¾-in. angles, two 18 x ⅝-in. side plates, and three 18 x ¾-in. cover plates. The top and bottom flanges are the same except that the latter were bent to conform to the reduced depth at the end of the girders corresponding with the depth of the girders in the shorter span. The top and bottom lateral systems are the usual X-brac-



Standard girders with H-chords and long spans with drop ends.

ing of single 6 x 4-in. angles, with connection plates engaging the horizontal legs of the flange angles. The intermediate sway frames are all X-braces of 4 x 4-in. angles.

The 70-ft. girders, actually 69 ft. 10 in. long, have moments of 4,259,300 ft.-lb., requiring a flange area of 41.6 sq. in., and a shear of 279,000 lb., provided for throughout by an 84 x ⅜-in. web, with two shop-riveted splices. The top flange differs from the bottom flange in that it has an H-shape cross-section with a gross area of 51.4 sq. in., and is made up of four angles with their vertical legs reinforced, while the lower flange has a T-shape cross-section with a net area of 42.47 sq. in., made up of a pair of angles having their horizontal instead of their vertical legs reinforced. The lateral systems are the same as in that the upper transverse strut has an I-shape section made with top and bottom flange angles latticed instead of plain angles.

The bridges were designed by the engineering department of the Canadian Pacific Railway, of which P. B. Motley is bridge engineer. The viaduct, weighing 785 tons, including 105.2 tons for the 114-ft. span and 40.6 tons for the 69-ft. span, was fabricated and erected by the Hamilton Bridge Works Company, of Hamilton, Ont.

The authorities in charge of the construction of buildings at Delhi, the new capital of India, are investigating a plan of providing outer and inner walls, between which artificially cooled air can be circulated by means of exhaust fans, the cooling being effected by drawing currents of air through wetted screens.

Plans are being prepared and tenders will be called shortly for another unit of the five-million dollar ship building plant which is being erected at North Vancouver, B.C., by the Dominion Shipbuilding and Dry Dock Company, Limited. The new work will comprise machine shops, two marine railway buildings and two concrete wharfs.

Forged iron and steel produced by rolling mills and steel works in Canada during 1913 aggregated about 23,405 tons, of which about 2,578 tons were iron and about 20,827 tons were steel. During 1912 the production was 22,415 tons, of which about 867 tons were iron and about 21,548 tons were steel, according to a special bulletin of the Bureau of Statistics of the American Iron and Steel Institute.

All would have been well, observes the Monetary Times, had Kaiser Wilhelm got J. F. Spence, of the Canadian Guardian Life, to insure his army; H. F. Malcolm, of the Western Canneries to feed them; J. W. Moyes, of railway fame, to electrify them; H. Pollman Evans, of the Union Life, to draft their policy; Mayor Martin, of Montreal, to finance them; Billy Macelan to run their banks; and Controller Church, of Toronto, to give them the "glad hand."

Advance-production curves, which are in fact estimated-progress curves plotted in advance of the work done, have been used by the Aberthaw Construction Company, of Boston. Their use, it is said, has made it possible to spread the whole work out more evenly, thereby keeping the force fairly constant for long periods, making the workman feel that his job is reasonably secure during the continuance of the construction work, and eliminating the disorder that results from the sudden influx of untrained men when part of the work must be rushed.

Water supply is an expensive item in starting a station in Queensland. Tank sinking costs about $4,000 for a 10,000 cubic yard excavation, and nothing less than this has much hope of holding out for long against the loss through evaporation. Many of the tanks are nearer 30,000 cubic yards. The alternative to a surface tank is an artesian bore, which involves risk and great expenditure. It is necessary to go down to anything between 1,000 ft. and 4,000 ft.; in fact, the deepest bore in Queensland is over 5,000 ft. Roughly speaking, boring works out at about $5 per foot.

Personal Mention

Mr. A. W. Post, Works Commissioner, and Mr. Robert Martin, Mayor, of Regina, were visitors to Toronto last week.

Mr. J. C. Ross has succeeded Mr. Henry Dodue as Chief Engineer of the Yarmouth Light & Power Company, Yarmouth, N.S.

Dr. Nasmith, of Toronto, left Valcartier with the First Contingent as Advisory Officer on Sanitation to the Canadian Expeditionary Force.

Mr. W. H. Ellis is Acting Dean of Engineering at the University of Toronto, filling the vacancy occasioned by the death of Dr. Galbraith.

Mr. Peter Lyall, President of the Lyall Construction Company, has been successfully operated upon at the General Hospital at Montreal.

Mr. Geo. P. Hugnot, formerly a member of the architectural staff of the Public Works Department at Ottawa, was wounded at the battle of the Aisne.

Mr. R. D. S. Beckstedt has been appointed Superintendent of the Tagona Water and Light Company, Sault Ste. Marie, succeeding Mr. R. A. Campbell.

Major E. C. Norsworthy, of Montreal, prior to his departure for the front with the Royal Scots, was elected a Director of the Canada Cement Company.

Mr. J. Chapman, of the American Well Works, Aurora, Ill., has been paying a visit to Medicine Hat and other Western towns with a view to locating a branch factory.

Mr. H. W. Scott, Manager of the Montreal Office of the Jeffrey Manufacturing Company, has resigned to establish himself in the engineering and contracting business.

Dr. L. A. Herdt, of McGill University, and Chairman of the Montreal Electrical Commission, has left for Europe, on private business. He will be away for several weeks.

Mr. Harry Edward Prindle, formerly Canadian representative of Messrs. Palmer, Hornbostel & Jones, has opened an office at 915 New Birks Building, Montreal, for the general practice of architecture.

Mr. R. C. Misson, Sales Manager, Eastern Division, Sherwin-Williams Company of Canada, Limited, has been appointed to the position of Manager of the Eastern Division, with headquarters at Montreal.

Mr. A. H. Ayers, formerly Division Engineer on the irrigation project of the South Alberta Land Company in Alberta, has been appointed Engineer of the Sun River project of the United States Reclamation Service at Fort Shaw, Mont.

Mr. E. L. Warner has been appointed eastern sales representative of the Dominion Paint Works, Limited, Walkerville. His headquarters will be at Toronto, but he will have control of the business of all the eastern provinces, with Montreal office at 411 Transportation Building.

Mr. Thos. Mawson, the well-known English town planning expert, has been engaged by the Conservation Commission at Ottawa to act in an advisory capacity in the work of encouraging more attention to town planning in Canada. His services have been obtained by an arrangement with the Local Government Board, of London.

Mr. H. Reginald Davison, Industrial Commissioner of Vancouver, is visiting Cincinnati, Ohio, Toronto, Montreal and Winnipeg. The journey is made necessary to conclude arrangements which are expected to lead to the establishment of new industries in Vancouver as the culmination of an extended correspondence with manufacturers in the cities mentioned.

Captain Ritchie is in command of an engineering corps raised at Toronto by the Canadian General Electric Company, for service at Quebec, Halifax, and Esquimalt. The corps is at the disposal of the government and it will be maintained by the Company until the war is over. The members of the corps are: H. S. Elliott, Charles Stewart, C. Pink, W. J. Swanger, F. G. Jackson, H. Williams, E. S. Shill, A. T. McLean, W. S. Johnson, J. S. Dunlop, G. Hillier, C. Henry, George Monaghan, A. Hardie, J. C. Munro, C. C. Rous, P. Foster, E. Crockford, H. S. McKean, A. J. Palmer, R. W. Nurse, H. Calvin, R. Bethune, H. Bestard.

Mr. George W. Coburn has been appointed district engineer for the Canadian Pacific Railway, with headquarters at Brandon, Man. Mr. Coburn started work for the Canadian Pacific in 1896 as rodman and draftsman at Farnham, Que. From 1900 to 1902 he was engaged on construction work on various parts of the system, and in 1902 became assistant district engineer and draftsman at Souris, Man., later at Brandon, Man., and then at Moose Jaw, Sask. Since 1907 he has been district engineer at Souris. Mr. Coburn is an Associate Member of the Canadian Society of Civil Engineers.

Mr. Charles A. Ellis, formerly Resident Engineer, Dominion Bridge Company, Winnipeg, has been appointed Assistant Professor of Civil Engineering at the University of Illinois. Prof. Ellis graduated from Wesleyan University, Middletown, Conn., in 1900. For a year he was Assistant City Engineer of Middletown, and for seven years Structural Engineer with the American Bridge Company at Berlin, Conn., New York City and Ambridge, Penn. He was Assistant Professor of Structural Engineering at the University of Michigan from 1907 to 1912, and since then has been with the Dominion Bridge Company.

Mr. H. C. Grant, formerly Superintendent of the Canadian Pacific Railway at Brownville Jc., Maine, and recently Assistant General Superintendent of the Atlantic division at St. John, N.B., has been promoted to be General Superintendent of the Atlantic division, succeeding Mr. William Downie, who has retired after a service with the Canadian Pacific Railway extending over 27 years. Mr. Grant is a graduate of the engineering staff of the railway. He was in the Construction and Maintenance-of-Way departments from 1898 to 1910, rising from the position of Rodman to that of Assistant Division Engineer at Toronto. Since 1910 he has been in the operating department.

Mr. W. P. Wilger has been made Professor of Civil Engineering at the School of Mining, Queen's University, Kingston, Ont. Prof. Wilger, in 1901, began engineering work as transitman on the Kingston & Pembroke Railway. In 1902 he was made locating engineer for the Bay of Quinte Railway, and later was resident engineer for that railway. In 1904 he became locating engineer on the Central Ontario Railway, and later in that year was placed in charge of a party on exploration for the Transcontinental Railway. For four years following he was locating engineer for the Transcontinental and from 1908 to 1911 was division engineer. Since 1911 he has been assistant district engineer.

Corps of Engineers organized by the Canadian General Electric Company for service in Canada. The men are distributed between Esquimalt, Quebec and Halifax.

Messrs. Kelly & Sons, contractors and brick manufacturers, Winnipeg, who were recently awarded a large contract on the Winnipeg aqueduct, have been in business under that name in Winnipeg since 1908, when Mr. Thomas Kelly, a contractor of 35 years' experience in that city, associated with him his three sons, Robert Emmet, Charles Bernard and Lawrence Corbett Kelly. The firm is at present engaged on the new Parliament buildings at Winnipeg, a contract amounting to over $2,800,000. Mr. Thomas Kelly, the founder and president, was born in Ireland in 1855, and went to the United States at the age of nine. He was educated in Oneida County, New York, and entered business in Winnipeg 35 years ago. He was founder and head of the firm of Kelly Bros., contractors, which firm became Kelly Bros. & Company, and later was merged into The Manitoba Construction Company, Limited, of which Mr. Kelly was president and manager from 1903 to 1905. He was then president and manager of Kelly Bros. & Mitchell, Limited, until 1908, when he established the present firm. Mr. Kelly is also president of the Manitoba Quarries, Limited, and the Master Builders' Liability Insurance Company. During his long career he has been the builder of many of the larger public and office buildings in the city and of the Canadian Pacific Railway shops, the Canadian Northern Railway shops, and substructures of several of the bridges across the Red and Assiniboine rivers at that place. The firm's contract on the great aqueduct includes the Brokenhead section, and will involve 300,000 cubic yards of earth and 6,000 cubic yards of rock excavation, 429,000 cubic yards of refill and embankment, 113,000 cubic yards of foundation, 75,000 cubic yards of concrete, and 1,460,000 lbs. of reinforcing steel. The contract price is $1,301,485.

Colin Maxwell, Contractor

Mr. Colin Maxwell, of Transcona, Man., whose photograph is reproduced herewith, is now engaged in general contracting practice in Western Canada. He is a native of Portage la Prairie, and in his early days spent some time with his father practising architecture. Later he became identified with such important constructional enterprises as the erection of the C. P. R. Station and Royal Alexandra Hotel at Winnipeg. In 1905 he went to Montreal in the service of Messrs. C. E. Deakin & Company, after which he was in full charge of the construction of a $1,500,000 reduction plant, and the installation of the machinery, for the Nickels Chemical Company, Tweed, Ont. For three years following he remained in the east, devoting his activities to various important enterprises. In 1909 he went to Winnipeg to tender for the G. T. P. shops at Transcona for Messrs. Haney, Quinlan & Robertson. He returned east with a tender which was accepted and was appointed to take charge of the work, which was completed last spring at a cost of some $5,000,000. Mr. Maxwell sticks to contracting pretty closely, but not to the sacrifice of other interests. He was the first Mayor of Transcona in 1911 and has served the municipality as School Trustee. He is a Freemason and a Forester, and he confesses to a predilection for motoring and shooting.

Mr. Colin Maxwell.

Mr. T. J. Kennedy, of the Superior Construction Company, Limited (Franz, Ont.), has gone to Sault Ste. Marie to assume control of the transportation utilities of the Lake Superior Corporation. The Superior Construction Company, Limited, are the contractors for the Algoma Eastern Railway, from Crean Hill to Whitefish, 43 miles, and for the Algoma Central and Hudson Bay Railway, from Hobon to the National Transcontinental, 101 miles.

A federal charter has been granted to the Imperial Pipe Line Company, Sarnia, Ont., capitalized at $1,000,000.

Mainly Constructional

East and West—From Coast to Coast

EASTERN CANADA

The Montreal office of Messrs. Palmer, Hornbostel & Jones, architects, was discontinued on October 1st.

At the recent convention of the Trade and Labor Congress at St. John, N.B., it was decided to hold the next meeting in 1915 at Vancouver.

Mr. A. F. Macallum, City Engineer of Hamilton, will report to the City Council on the road work that can be put in hand during the fall and coming winter.

The new post-office at Collingwood, Ont., built at a cost of $108,000, is practically finished. The contractors are Messrs. Healy, Herrington & Bryan, Collingwood.

The Algoma Steel Corporation, Sault Ste. Marie, Ont., are busily engaged in the manufacture of certain parts of 200,000 shells which are being turned out in Canada for the artillery.

The building permit for the new Customs House now being erected on Sussex street, Ottawa, places the estimate of cost at $1,173,000. The foundation work was exceedingly difficult and cost over $500,000.

Mr. Geo. Janin, Chief Municipal Engineer, at Montreal, has been instructed by the Board of Control to report upon works which should be completed this season. The sum of $1,500,000 is available for such undertakings.

Mr. J. F. Whitson, who is in charge of the Northern development work for the Ontario Government, reports that $2,500,000 has been expended in road work and that between 800 and 900 miles of roadway have been improved.

The representative of an English syndicate was at St. John, N.B., recently, enquiring into housing conditions. It is said that he was negotiating for a site in the eastern end of the city for the erection of one hundred or more workmen's dwellings.

At Fort William it is reported that the Superior Brick Company's plant will in all probability be kept in operation continuously until the spring. The Company have just been awarded the contract to supply upwards of 1,000,000 bricks for use in the construction of G. T. P. roundhouses.

Tenders for the foundation work in connection with the new hospital building which is to be erected at Hamilton, Ont., at a cost of $200,000 will be called shortly and the remaining bids will be received in the spring. The architects are Messrs. Stewart & Witton, 2 Hughson Street S., Hamilton.

Good progress is being made on the school building which is being erected on Charlotte Street, London, Ont., by the Board of Education. The school is two storeys high, of brick construction, and will cost $100,000. The architects are Messrs. Watt & Blackwell, and the general contractors Messrs. J. Moran & Son, both London firms.

At Toronto, tenders for an office building estimated to cost $300,000, for the Provincial Hydro-Electric Commission, are being received until October 19. The building, which has been designed by the Company's engineers, is to be of steel and brick construction. The Secretary of the Commission is Mr. W. W. Pope, Continental Life Building, Toronto.

Welland, Ont., is rejoicing over the news that her youngest industry, the Electric Steel & Metals Company, Limited, is to begin operations at once with a staff of two hundred men. The Company have received from the British War Office a contract for shrapnel shells which will keep one hundred and sixty men employed continuously until next April.

According to a report from St. John, the western section of the spandrel arch bridge across the St. John River is now completed and the eastern section is well advanced. The steel work, which is under contract by the Dominion Bridge Company, will be completed before winter sets in. The bridge, which spans the Reversing Falls, will be ready for use in the spring.

An Owen Sound reader predicts a great revival in the iron trade. Writing to the Contract Record he says that the country will soon be off to the greatest race in Made-in-Canada goods it ever knew, and that incidentally the iron and steel works of Owen Sound will reap the benefit. Already the factories are working in full force to keep up with the orders for transport and artillery vehicles. The foundries are equally busy turning out shells for artillery ammunition. As a side issue, the boom makes things lively for tent-makers, canvas-workers, knitting factories, clothing manufacturers and leather workers.

WESTERN CANADA

The British Columbia Sheet Metal Works, Limited, Vancouver, B.C., has been incorporated with a capital of $10,000.

The new building erected at Edmonton for the Bank of British North America has been completed at a cost of some $160,000.

The Sidney Island Brick & Tile Company, Limited, Victoria, capitalized at $150,000, is a new British Columbia concern to receive a charter.

A bridge estimated to cost $750,000 is under contemplation at Victoria, B.C., and the ratepayers will be asked this year to vote on a by-law to raise the required amount.

At Saskatoon, the total fire losses during the month of August amounted to rather more than $3,000,000. The fire insurance rates at Saskatoon are the lowest in Saskatchewan.

The new plant of the Maple Leaf Milling Company, at Medicine Hat, is practically completed. The contractors for the building are Messrs. Geo. H. Archibald Company, Winnipeg.

At Vancouver, operations are about to be commenced on the Balaclava sewerage project. The cost of the work is estimated at $150,000. Tenders for the material will be called shortly.

At Prince Rupert, B.C., the G. T. P. have decided to build a large dry dock capable of accommodating a 20,000-ton battleship. Constructional operations giving employment to several thousand will be started on January 1.

Construction work is to be commenced this fall on the factory and office building in Manchester, a suburb of Calgary, for the Western Canada Cordage Company, Limited. The building will be 400 ft. by 120 ft. in dimensions and will cost approximately $150,000.

At Regina, public works to the value of approximately $350,000 will be proceeded with at once. The undertakings scheduled for completion include a 5,000,000-gallon reservoir, filter beds at the sewage disposal works, the Isolation Hospital and the proposed water and sewer extensions.

The new building which the Winnipeg Public School Board is erecting at the corner of Manitoba and Power Streets, at a cost of $150,000, is advancing rapidly towards completion. The building has three storeys and basement, and is of brick, stone and reinforced concrete construction

The steel work on the new Winnipeg warehouse now being erected by the Coca Cola Company, of Atlanta, Ga., at a cost of $550,000 is completed. The architect is Mr. Arthur Tufts, Baltimore, Md., and the general contractors are Messrs. Jos. McDiarmid Company, Canada Building, Winnipeg.

The large bridge with which the C. P. R. is spanning the Saskatchewan River east of Empress, Alta., is nearing completion. It is hoped to have the new line from Swift Current to Bassano completed by October 15. The contractors for the steel work of the new bridge are the Canada Bridge Company.

A new school building at Prince Albert, Sask., erected by the Separate School Board at a cost of $100,000, is nearing completion. The building is two storeys high, of concrete block and red brick construction. The architect is Mr. A. Graham Creighton, and the general contractors are Messrs. Bonas Bros.

The Provincial Highway Board of Saskatchewan is cooperating with the various municipalities throughout the province with a view to increasing the expenditure on road and bridge work. Already arrangements have been made for the expenditure of some $500,000, and some two hundred road gangs are in operation. The Chairman of the Board is Mr. F. J. Robinson, Regina.

From Edmonton comes the report that a Company to be known as the Conotolite Marble Company, is to be formed for the manufacture of a new invention called Conotolite marble. The new building material is said to have disclosed remarkable properties in regard to tension strength and crushing power. Those interested in the project are Messrs. D. Kennedy, R. W. McKennel, H. E. McLuhan, P. R. Schick, W. F. Brown and W. F. Cavanagh, of Edmonton.

The Hare Engineering Company, Limited, Toronto, manufacturers of power plant equipment and special machinery, have removed from 78 Duchess Street to more commodious quarters at 115 King Street East.

Good roads men are reminded of the Fourth American Road Congress, which is to be held at Atlanta, Ga., November 9-14. Special trains for the meeting leave New York City on November 7. Western delegates will be accommodated by a special train from Chicago. It is stated that forty-seven National and State Associations will take part in the meeting. Detailed particulars may be obtained on application to the Secretary of the Congress, Mr. I. S. Pennybacker Colorado Building, Washington.

An interesting new standard overhead crane has been introduced to the Canadian market by the Herbert Morris Crane & Hoist Company, Limited, A description of this crane is embodied in bulletin B9, of which a copy has just reached us. Instead of running on the top of a rail, as is usual in overhead traveling cranes, the type "S6" is designed to run on the lower flange of two parallel I-Beams. These may be existing roof beams or special beams simply attached to the roof trusses. What will strike every practical man is the reduction of first cost made possible by the elimination of the usual brackets. Another feature is that the stresses on the structure itself are much simplified. Sometimes the wall of a building would carry the crane, crane runway and load vertically, but it is too weak to resist the overturning effect of an ordinary crane carried on wall brackets. Another advantage possessed by the type "S6" crane is to be found in its ability to connect up with a Morris overhead runway. The combination is a source of much time-economy, as it eliminates many useless re-handlings of the load.

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Alphabetical Index of Advertisers
Page 18

Vol. 28 **October 21, 1914** **No. 42**

Principal Contents

Page
The Exigencies of the Present 1283-4
The New Hastings Street East Viaduct at Vancouver 1284-5
Heavy Construction Work on the G. T. P. Railway. 1286
Adding Hydrated Lime to Concrete Mixtures 1286-7
Building Bridge Substructures on the Grand Trunk Pacific Railway 1287-9
By W. C. Reugnitz
The Selection of Dust Preventives 1289-90
Quebec Bridge Anchor Arm Diagonal and Posts .. 1290-2
Concrete Poles and the Possible Maximum Load on Pole Lines 1292-3
Proposed St. Denis Theatre, Montreal 1293
Arrangement and Operation of the Canada Cement Company's Plant No. 1 1294-1300
Cement in Lumber Dry-Kilns 1300-1
By G. D. Crain, Jr.
Unprecedented Trussed Spans 1301
Permissible Pollution in Raw Water to be Filtered for Domestic Consumption 1302-3
By Geo. W. Fuller
Bituminous Surfaces for Concrete Roads 1304
By W. H. Fulweiler
Liquids Used in Paints 1305
By A. Ashmun Kelly
Going After Business 1306-7
By A. A. Briggs
Considerations for the Designing Engineer 1307
Constructional News and Notes 1308-9

The Exigencies of the Present

THE manner in which the exigencies of the present situation can best be met, having regard to the possibilities and prospects of the future, was considered editorially in our issue of September 23. Since the publication of that issue we have received many letters, varying in degrees of optimism and pessimism, dealing with the situation and outlook in the constructional world from the individual viewpoint.

The communication which shows the best balance is that from a large Western bridge building and structural steel firm, whose business was affected considerably by the restriction of building operations which followed the outbreak of hostilities in Europe. Our correspondent deals with three fundamental aspects of the situation, viz., (1) the attitude of the banks; (2) reduced cost of construction as an inducement to capital; and (3) the disposition of the labor organizations.

In regard to the first of these considerations, our correspondent finds common cause with us in deploring the criticism of the action of the banks. Such criticism, it is pointed out, is unavailing and tends to disturb business stability. Among the responsible constructional heads of Western Canada it is regarded as fortunate that the banks took the steps they did over a year ago in preparing every one for the conditions which have arisen since. If it were possible for the banks at this juncture to loan money freely on constructional enterprises it would not be long before much of it would be put to speculative uses, in which event the last condition would be more disastrous than the first. The banks have their own obligations and they have great responsibilities and it is only natural that they should set the example in putting into effect a temporary policy of conserving the country's financial resources.

Under no circumstances can a policy of aggressive business enterprise and liberal expenditure be justified during the present period. On the other hand, with such reasonable certainty of a successful issue there can be no defence of a self-sacrificing, short sighted policy of retrenchment. The one course is optimism gone mad and the other is business suicide.

Extremes are dangerous in every walk of life. It is the middle course which leads to success. The middle course in Canada to-day is holding what we have and keeping an eye on what we have not. Such a course involves close adherence to the principle of "business as usual," at the same time precluding the more or less speculative phases of business enterprise which are justified under normal conditions.

Our correspondent passes on to the second aspect of the case and expresses the view that unless capital can be convinced that the present reduction in cost is only temporary, constructional enterprises of all kinds will continue to be hampered and delayed. This, of course, has no application to public works in which the revenue is guaranteed by governments or municipalities. In regard to private enterprises throughout the country, one cannot urge too strongly upon engineering and contracting interests the advisability of presenting strong optimistic arguments relative to the temporarily reduced cost of construction brought about by the first and worst situation created by the war. In all conservatism it may be asserted safely that never again in our day and generation will there be such an opportunity for the man with money to make money as the present. The general principle of the argument, presented forcibly, and reinforced by local facts and local figures, cannot fail to exercise an influence in the right direction.

The third and final aspect with which our correspondent deals is the attitude of the labor organizations. In Western Canada—not alone in Western Canada, but in the west particularly—the recent attitude of the labor organizations has been most unfortunate, to say nothing of its being ill-advised on their own account. Contractors have been hampered by an obstinate policy on the part of the men's executives to hold out at all costs for the maintenance of the same wage scale which obtained before the war. Such a policy cannot but tend to destroy the influence of the organizations. If continued, it will lead to their disruption, for already there is in evidence an inclination on the part of various trades to throw off the restrictions laid upon them by the unions and to meet any reasonable proposition made by the employers. It is doubtful whether any concerted plan looking to the encouragement of construction work could be adopted as between contractor and employer, but when prospective business is in view it would seem that the contractor should take the matter up with the men individually or in small groups and make arrangements which will enable him to secure labor and prices at considerably lower rates than have prevailed during the last five years—rates at which under the present conditions of close figuring a fair profit is not possible.

In a measure the views expressed herein are a reflex of those which have been advanced from time to time in the editorial columns of this journal, but in the condensed form in which they are submitted and enlarged upon we believe they offer a policy of sound commonsense. In any case they are interesting as emanating from an aggressive Winnipeg company whose ramifications during the last few years have extended into every corner of Western Canada.

The New Hastings Street East Viaduct at Vancouver

THE grade crossings of the Great Northern Railway in the east end of Vancouver have always been a decided drawback to the development of that section of the city. About three years ago the question of providing overhead bridges on the streets affected became a live issue, with the result that plans and estimates for the construction of four viaducts were prepared in the City Engineer's office and submitted to the Railway Commission which in 1912 finally approved of the scheme and apportioned the cost to be paid by the parties interested therein, comprising the city, the B. C. Electric Railway Company, Limited, and the Great Northern Railway Company. It was proposed to erect bridges over Hastings, Pender, Keefer and Harris streets respectively, the "Mushroom" or flat slab type of reinforced concrete construction being eventually chosen for all four structures in preference to steel construction as was originally planned, a considerable saving being effected thereby. Following the consent of the Railway Commission the city engineer's department turned out designs for the "Mushroom" construction, these being later checked over and approved by Mr. C. A. P. Turner, the inventor of the system. The city then called for tenders and on March 9, 1914, awarded the contract to the Union Contracting Company at a price of $299,930 for the four bridges. A month later work was started on the bridge which carries that portion of Hastings Street East lying between Campbell Avenue and Glen Drive, over the Great Northern Railway tracks, this being the only structure proceeded with, the other three crossings being allowed to remain in their original state until such time as the money is available for their improvement. The length of the Hastings Street East viaduct is 616 feet between abutments and 99 feet wide—the total width of Hastings Street. Provision has been made for two 18 ft. 6 in. concrete sidewalks, the width of the road between curbs being 62 feet. Double street car tracks extend the entire length.

The street paving consists of 4-in. wood block on ½-in. 3 to 1 sand and cement cushion. The handrailing on both sides of the bridge consists for the most part of concrete posts and iron pipe, only a small portion, that over Glen Drive and the railway tracks, being of ornamental cast stone.

The contractors met with practically no difficulties when sinking the footings. It is true that in some places it was necessary to go down deeper than had been anticipated but this caused very little inconvenience.

Between Campbell Avenue and the west abutment of the bridge there is a fill varying in depth from zero up to 8 feet and retained by timber bulkheads on the north and south sides of the street. Wood block pavement and concrete sidewalks of similar width to that on the bridge have been laid on top of the fill. The thickness of the slab varies from 15 inches in the 25-foot spans to 22 inches in the 45-foot span over Raymur Avenue. A trench about 6 inches in depth and 18 feet 6 inches wide was allowed to remain in the centre of the slab until pouring had been completed and a reasonable time for setting allowed to elapse. The B. C. Electric Railway Company then proceeded to lay the street car tracks in the trench, the non-rigid type of track construction being installed owing to the comparative shallowness of the track allowance in this particular instance. The rails are 4¼ inches deep laid on fir ties 4½ inches deep x 8 inches x 8⅛ inches long, using screw spikes and ¼-inch steel tie plate. The tracks have been surfaced to the proper grade on 1-inch sand cushion laid beneath the ties, and the ties completely surrounded with concrete preparatory to paving with wood block. Rail joints of the continuous type were used in order not to interfere to any serious extent with the stresses in the bridge structure. Screw spikes were preferred in this case on account of the decreased depth of the ties. In order to protect the screw spikes and the tops of the ties from water seepage through the paving, the ties have been coated over with creosote oil and the spike holes given similar treatment.

The reinforcing of the structure is of the usual "Mushroom" type, the panels being reinforced longi-

Laying sidewalks and street railway tracks in west approach, Hastings Street viaduct.

Method of laying street railway tracks across the viaduct.

tudinally, transversely and diagonallly by belts of rods varying in width from 12 feet to 15 feet according to the size of the spans. The columns are all octagonal in shape, 3 feet in diameter, and reinforced with six 1⅛-inch steel rods with spiral hooping having a pitch of 3 inches. The "Mushroom" tops for the columns are of the usual design. Two expansion joints have been provided in the full length of the bridge, one at each abutment, the joints consisting of galvanized iron and sand. The slab was allowed to slide over a surface which is of galvanized iron, the surface of the slab angle being provide to cover the space left by expansion. The retaining walls are of the reinforced concrete counterfort type, the depth of these being 18 and 16 feet in the east and west abutments respectively. No piling was used in the viaduct for any of the footings, a sufficiently hard strata being reached at a reasonable depth below ground. The foundations for the columns comprised two concrete slabs reinforced four ways, the size of these varying, of course, with the size of the spans. The columns were all carried down to hard pan and the water was pumped out of each footing and prevented from encroaching during the time concrete was being poured. The footings were also kept perfectly dry when pouring was proceeding at the foot of the columns, thus ensuring perfect concrete at the bases.

The gravity system of pouring concrete was employed on this work. Bunkers were built on a vacant lot opposite the centre of the bridge and a teamway leading to the top of the bunkers was used by the contractors for delivering material. Underneath the bunkers a measuring chamber was erected into which the material was conveyed by gravity from the bunkers and then passed through to the mixer placed directly below. From there the concrete was loaded into the bucket and hoisted by means of an electric winch to the top of the tower, 210 feet from the ground, and dumped into the hopper. The operation of releasing the concrete from the hopper into the chute was controlled by a gate regulated by a workman on the hopper platform. Immediately after pouring had commenced it was discovered that a grade of at least 33 per cent. would be required on the chute to ensure free running concrete.

The contractors started pouring the slab on July 23 last and finished this section of the work on September 11, the average amount of slab poured every sixteen hours being 25 feet for the full width of the bridge.

The entire work has now been completed with the exception of the wood block paving which it is hoped to have fully laid by November 1.

Form faces on the track elevation work of the Chicago, Milwaukee & St. Paul Railway north of Wilson Avenue, in Chicago, are held together by cables made of eight strands of No. 10 wire prepared with a butterfly nut on each end in a special cable twister operated by two men. The butterfly nuts are threaded to receive short bolts passing through the forms. These nuts are made by the thousand in the shops of the railroad company. Occasionally six-strand cables break, but with eight strands no forms have given trouble. The cables are spaced on 3-ft. 4-in. centres vertically and on 4-ft. centres horizontally. Six 25-ft. cables are used to hold the bulkheads against the ends of the side form faces. The twister is composed of two 6 x 6-in. braced timber uprights, one of which is fixed and the other movable, mounted on a timber base, and fitted with a hand-operated crank.

Arrangement for mixing and delivering concrete.

Bird's-eye view of the viaduct, looking east.

Heavy Construction Work on the Grand Trunk Pacific Railway

WHILE the Grand Trunk Pacific Railway has secured a specially favorable location for the Rocky Mountain section of its transcontinental line as far as grades and a low summit elevation go, the construction of this part of the line has been attended with exceptional difficulties, says Engineering News editorially, referring to an article abstracted elsewhere in this issue. These difficulties arise from three causes: the severe winter climate, the topography and almost inaccessible character of the country, and the character of the streams which had to be utilized for transportation of material.

The necessity for expediting the progress of the work made it necessary to commence construction at various points, and this, in turn, made necessary the transportation of men, machinery and supplies to points not only difficult of access but often cut off entirely from any means of communication.

In ordinary railway construction it is usual practice to build temporary bridges in advance and thus to have a line of communication open with the base of supplies. But in the case of the Grand Trunk Pacific Railway there were many cases where temporary bridges could not be built or would be constantly liable to destruction, and it was desired to have the substructures for permanent bridges built in advance, so as to be ready for the steel superstructures when the tracklaying reached them. This necessitated establishing construction camps in distant mountain regions, where the means of communication were very limited and were liable to be interrupted entirely for considerable periods. Under such conditions ample supply of provisions, equipment and machinery parts was essential. Still more essential was the placing of the work in the hands of resourceful men who could turn emergencies into opportunities and could keep the work in progress whatever might happen.

Where the line follows the general course of the Fraser River, the river was adopted as a means of distributing material to the construction points, including the three long bridges which cross it. The river is navigable only at high-water period, which is during the summer, and is then too high and turbulent for construction work in the stream. The low-water period available for bridge construction occurs during the winter, which is very severe, the temperature continuing at 40 to 50 deg. below zero for considerable lengths of time. Under these conditions, much of the heavy material and supplies had to be taken to the sites in summer, by means of scows floating down a dangerous channel with a wild current and numerous rapids. In winter, with everything frozen solid, the coffer-dams were built, excavations made, and concrete deposited for the foundations and piers. But the work was planned to meet these conditions and was carried out successfully, while the concrete proved to be of excellent character, indicating once more that proper precaution and expense can make winter concreting quite practicable.

In winter there was communication by sled on the river, except when the snow was too deep, and this was the most favorable time to deliver material, owing to the dangers of navigation in summer. During some winters, there is comparatively little snow, and in the hope of experiencing this condition the bridge contractors purchased and delivered a large motor truck with trailer wagons. Their hopes were not fulfilled, however, and the heavy snow made this costly equipment quite ineffective. In one case, materials and plant were hauled by sleds about 150 miles over the frozen river, between points about 100 miles distant by the future railway but quite inaccessible by land. For another of the bridges, a considerable part of the material was carried on scows for nearly 300 miles.

Adding Hydrated Lime to Concrete Mixtures

SPECIFICATIONS usually call for hydrated lime as a certain percentage of the cement and the question often arises just how to proportion 10 per cent. or 15 per cent. of hydrate for the mix. A recent issue of the Mason Builder presents an interesting discussion of this problem.

Assuming that a sack of cement weighs 94 lbs., a 10 per cent. proportion would require 9.4 lbs. of lime hydrate. To secure this 10 per cent. dump the hydrate into a large wheelbarrow, or other convenient receptacle, and have made a box of the following interior dimensions: 8 ins. wide x 8ins. long x 6 ins. deep. This box, filled level full, should be added to the mixture for each bag of cement used. To secure 15 per cent. by weight of lime hydrate, have made a box of the following dimensions: 10 ins. wide x 10 ins. long x 8¼ ins. deep. This box, filled level full, should be added to the mixture for each bag of cement used.

Perhaps an easier way of measuring would be to use a bucket. An ordinary 8-qt. bucket, filled level full, contains the same number of cu. ins. as the first box named and would be equivalent to 10 per cent. by weight of a bag of cement. For a 15 per cent. mixture a bucket holding 14½ qts. or 3½ gals. should be used. As there is no bucket made of this size, it would be more convenient to use the 8-qt., or 2-gal. bucket mentioned above and fill it up one and a litle over half again for 15 per cent.

While discussing the subject of the use of hydrated lime for the purpose of "watertightening" concrete, it is well to dwell on the question of whether or not it is best to add the hydrate or to substitute it for an equivalent amount of cement. As an example let us say that we have a 1:2:4 mix. This gives 100 lbs. as a unit representing the cement. Adding 10 per cent. to this we would make 110 lbs. of cementitious material.

If the lime is considered as an addition it would not change the proportion of the sand or the aggregate and they would remain 200 lbs. and 400 lbs. If, however, the lime hydrate was intended to displace 10 per cent. of the cement, then the totals would be 110 lbs., including the cement and the lime, 220 lbs. the sand and 440 lbs. the aggregate.

There is still a third way of handling this proposition and that is to take out from the batch of cement an amount equivalent by weight to the lime put in. In other words, we would then have 90 lbs. of cement, 10 lbs. of hydrated lime, 200 lbs. of sand and 400 lbs. of aggregate.

Investigations which have been carried on for some time past tend to show that such substitution of lime hydrate does not weaken the strength of the concrete as has been contended in some quarters. Concrete in which a percentage of lime hydrate has been substituted instead of added, gradually gains in strength until at a certain period it becomes even with concrete made without lime. From this point on the concrete containing the hydrate continues to gain in strength at the same ratio. This, of course, refers to tensile strength, and since the concrete made with the lime hydrate is more nearly impermeable to moisture, it naturally follows that it would be the more permanent and enduring material of the two.

It is well known that the principal cause of disintegration in concrete is the absorptive nature of the material and in the proportion of absorption lies the length of life of the concrete. This is equally true of stones found in nature.

Recently the U. S. Government ordered taken down from one of the largest and most imposing structures in Washington some gigantic columns of sandstone which had begun to disintegrate and crumble away. The cause of the disintegration was the absorptive quality of the sandstone. Sandstone being somewhat like a sponge, absorbs water, and the constant expansion and contraction of this water held in the interstices of the stone causes the particles to become loose and in the case of the sandstone to scale off. Extremely hard stones such as granites and crystalline marbles are practically indestructible as far as the elements are concerned because they are known to have very little absorptive quality.

When concrete is produced without any voids or, in other words, a homogeneous mass into which moisture cannot penetrate, then we have a perfect concrete. This is what hydrated lime tends to accomplish when it is used intelligently. The addition of the lime hydrate not only makes the concrete mass more plastic and easier to manipulate, but it causes the concrete to flow more readily. In the case of concrete work for decorative purposes, the addition of hydrated lime has the effect of lightening the color of the cement and makes a more even and uniform job throughout.

Building Bridge Substructures on the Grand Trunk Pacific Railway*

By W. C. Ruegnitz†

ONE of the most interesting features of construction on the Pacific Coast section of the new transcontinental line of the Grand Trunk Pacific Railway is the bridge foundation work along the Fraser River between Tete Jaune Cache and Fort George, in British Columbia. For 185 miles between these points the railway follows the Fraser River through several ranges of mountains, the distance by river being 300 miles. The country is wild and rugged, and inhabited mainly by Indians and trappers.

In the summer the melting glaciers and snow turn the streams into deep, swift rivers, and because of the scour and swift current exceptionally good foundations are required. Temporary bridges could not be maintained over the larger and more dangerous rivers, and it was necessary to complete the substructures in advance of track in order to allow the quick erection of the superstructure when tracklaying reached the various bridge sites.

There are ten permanent bridges, from 2,658 ft. in length to single-girder spans, and the three longest bridges cross the Fraser River. The substructure work of these bridges was commenced by some small individual contracts, but it was soon evident that it could not be carried on satisfactorily or with the necessary speed. In July, 1912, the contract for all the bridge substructure work from Tete Jaune Cache westward for some 450 miles or to within about 200 miles of Prince Rupert (the Pacific terminal) was awarded to the Bates & Rogers Construction Co., of Chicago. The writer was superintendent of construction for this company on the division between Tete Jaune Cache and Fort George, and work on this division was completed in May, 1914.

Supplies and Camps

To complete the difficult foundations in the short time allotted and under the conditions described, necessitated very careful preparation. Markets for labor, plant and material were far away. Men were often shipped from Montreal and Boston, a trip of 10 to 14 days. Cement and steel from eastern Canada and Pennsylvania, requiring a lake and rail shipment, were often weeks in getting to destination. The base of supplies was at Tete Jaune Cache, at the end of the track. Here it was necessary to assemble all requirements to be freighted to the bridge sites.

The nature of the country was such that wagon roads were impossible, and the only means of delivering material was by boat or scow on the Fraser River, which is navigable only during the high-water period. Actual construction had to be carried on during the low-water period, which begins usually in October or November and continues until April or May. Thus the high-water period was a time of preparation. Camps had to be established quickly, and plant, supplies and material had to be assembled and stored at the various sites. The smallest details had to be carefully worked out in advance, as each camp would be without freight communication during much of the construction period.

Stern-wheel steamers of the usual river type were built to handle the freight but they could not begin to deliver all the enormous tonnage. Hence hundreds of scows 36 to 40 ft. long, 12 to 14 ft. wide, and carrying 12 to 25 tons each were floated to the jobs. They were handled by sweeps at both ends, each sweep being manned by two men. In the more dangerous canons and rapids, pilots and extra men were put on to assist the regular crews, but even with this precaution entire cargoes were frequently lost. The average mileage per day for a scow was fifty miles, while one would frequently make 70 miles. Their progress was augmented by the swift currents and the long summer days of the North.

Nearly all cement was delivered by scows that were from 5 to 14 days on the way. False bottoms, covered with straw to absorb the moisture, served as a floor to receive the cement. The sides and ends of the cargo were also protected by straw, while the top was covered with a heavy oiled canvas. Run boards were provided to protect the cargo from the boot calks worn by the river-men. From the time the cement left the mill until stored on the job it was handled eight times.

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*Engineering News.

†Superintendent, Bates & Rogers Construction Company (of Chicago), Prince George, B.C., Canada.

The camps presented exceptional requirements. Ample storage room was necessary to accommodate the material and supplies that had to be delivered in advance of construction. Preparation for the long cold winter had to be made, and bunkhouses of logs well banked were used when lumber could not be easily procured. Sanitary conditions had to meet the requirements of the British Columbia Government. During the fall, when it was impossible to deliver fresh meat from the base of supplies, cattle were driven to the camps or trappers furnished the contractors with caribou or moose meat.

When navigation was closed, the only means of getting to camps was by walking. Mail and small supplies were packed in. During the colder months, dog teams were used, and teams and sleds when the ice permitted. A single-line telephone system serving all the camps provided a wonderful help, although the line was not as good as the ordinary party line of the rural settlements. Most of the camps were located in heavily wooded districts, and fuel for all uses was cut during the summer months. Foundation piling and round timbers for construction purposes were cut in the fall and delivered to the sites by water before ice closed the river. Square timbers were hewed on the job, there being many expert broad-axe men available.

Substructure of the Fraser River Bridge

All the bridges presented special difficulties but the largest and most interesting is that at Fourth Crossing, one mile east of the old Hudson's Bay Company Post, known as Fort George. It is just below the confluence of the Fraser and Nechaco Rivers. Here the line crosses an island, with the deep-water channel, known as the Fraser, on the east side, while the Nechaco, an overflow channel during high water, is on the west side. The length of the bridge is 2,658 ft. There are ten spans of 200 ft. and two of 250 ft., one at either end of the 100-ft. lift span. The truss-seat elevation at pier No. 1 is 1,867 ft. above sea level, and the elevation of the river bed is 1,823 ft. High-water level is assumed as 1,858 and the low water as 1,839.

The ideal location of the island was utilized by the contractors for their camp, accommodating 600 men. This was laid out in streets. The bunkhouses were frame buildings covered with prepared roofing. The storehouses for cement and material were large frame buildings covered with heavy oiled tarpaulins or "tarps," an exceptionally fine canvas made in Scotland. Tarps that had protected the cement on the river trip were used to cover the buildings. An auxiliary camp to accommodate 100 men was established on the east bank, on account of the great danger in taking laborers across the main channel during the ice floes before the contractors' temporary bridge was completed. This proved very fortunate, for in the spring, when the ice took out all temporary structures, the work on the east bank was carried on without interruption.

A complete day and night organization was maintained for the entire work, each pier having a complete plant layout as well as an individual crew. A night and day foreman for each pier worked together, shifting their crews every two weeks. Each foreman reported to the general foreman, there being one general foreman for each shift. The general foreman reported to the superintendent in charge, who was located on the work.

The substructure consists of 12 concrete piers and two abutments, all resting on pile foundations, as shown. The deepest foundations are at piers Nos. 1 and 2, which were carried 25 ft. below low water, requiring 40-ft. steel sheeting. An ice jam which raised the water several feet above the top of the sheeting delayed the operations for several days. Careful soundings were taken before the work was started and showed a gravel bed with an underlying strata of very stiff sandy clay with layers of quicksand. The depth of gravel varied at different pier sites.

An exhaustive study of the individual pier and abutment sites was made by the contractors, and cofferdams were designed both as to kind and strength to suit the local conditions. Three types of cofferdams were used; crib, steel sheeting and a single row of Wakefield wood sheeting. The size of cofferdams was designed to allow ample room for the necessary cofferdam piles, bracing and timbers. The braces were spaced in order to allow of dredging with grab buckets and to permit the placing of pumping equipment.

Actual work on the shore was commenced in September, 1913, on the east abutment and pier No. 6, the only units then accessible. The temporary bridge from which all work was directed was started at this time and carried out as far as navigation laws permitted. Later, when floating ice stopped navigation, it was found a very difficult task to drive the remainder of the bridge and it was not until January that it was entirely completed. The river, with a current of 4½ to 5 m.p.h. and filled with ice, presented a formidable obstacle not only against the temporary bridge but it seriously hindered the placing of the cofferdams.

The general program of construction for each pier was as follows:

1. Open dredging was carried down as far as possible.

2. The cofferdams were then built. The crib cofferdams were built and sunk in the ordinary way. For the steel cofferdams, wood piles spaced 8 ft. centre to centre were driven around the space to be inclosed; these were carefully lined up and two sets of timbers 4 ft. apart bolted on the inside piles (above the water) to act as guides for the steel sheeting. Three or four complete sets of waling and bracing were then sunk into position and set as deep as possible. The steel sheeting was then set inside the guide timbers and around the waling, care being taken to get a locked dam. After closure the steel was driven the full depth required, usually 6 ft. below the elevation required for the bottom of the foundation.

3. Excavation inside the cofferdam was continued with dredges teeth being used on clam-shell buckets when clay was encountered. The waling and bracing was usually carried 1 to 2 ft. below the bottom elevation required, in order to allow for swell caused by driving the foundation piles.

4. When excavation was completed, the foundation piles were driven and cut off under water at the eelvation required by means of a saw. The penetration of this piling usually averaged over 20 ft. below cutoff. The driving was very hard.

5. Concrete was then placed under water by means of bottom-dump buckets, using a 1:2:4 mixture. The amount of sealing used was carefully figured to prevent floating or "blow-in." The sealing was allowed to set from two to six days, depending upon the depth of water and temperature.

6. When the concrete was properly set the cofferdam was pumped out. As the water was lowered, the

bracing was examined and strengthened or repaired if necessary. The results in all cases showed exceptionally good masonry.

7. Forms were built and the pier concreted, using 1:3:5 mixture, the necessary precautions being taken (as described below) to protect it against severe weather.

Concrete Work

For the Fraser Channel, two concrete plants were used, one on the island and one on the east bank. Gravel was taken from the river and stored in a network of hollow boxes into which steam was turned, thus keeping the gravel hot even during weather 50 deg. below zero. Cement which had been delivered by scow was stored at both mixer plants. The concrete was taken from the mixer to the piers in buckets on cars handled by an endless cable. It was delivered so quickly that it was not affected by the cold before being put into the forms.

On the Nechaco Channel, enough gravel was obtained from the excavation of each pier, and a mixer was set up at each pier; the only material to be hauled being cement.

To prevent freezing, the gravel was heated as mentioned above. Water was also heated, the mixed concrete coming to the forms very warm. The forms were entirely covered by heavy oiled canvas tarps, these extending from the top of the cofferdams to the top of the forms, completely inclosing the pier. Between the forms and canvas covering, fires were kept in small stoves, or steam heat was furnished in radiators built on the work. Both methods are good but steam was preferred and used where there was an available supply on account of danger of fire from the stoves.

Steam was always turned in at the top of pier when completed. Heating was continued for 3 to 7 days after masonry was placed and the forms were stripped in from 7 to 10 days. The results obtained were remarkable. The masonry is smooth and of a uniform color and there are no indications that frost penetrated anywhere.

The forms had to be well built and braced with more than ordinary care before placing concrete, because the canvas covering did not leave an opportunity to examine the forms to determine if they were being kept in line.

Progress Records

The weekly progress report used by the contractor was a white print 28 ins. long showing an elevation and plan of the bridge (on which the concrete progress was marked) and a profile of the river bed on which the progress of coffer-dams and pile foundations was marked. On the print was a table for the excavation, coffer-dam, piling and concrete at each pier, the table being filled in each week. In addition to this, a monthly report was made for each pier or abutment, showing the progress, materials used, etc., and the condition of the work. These graphic reports were made up at the superintendent's office and forwarded to the main office of the contractors, in Chicago.

For fireproofing and for various other purposes requiring low stresses, cinder concrete is often used. The cinders should consist of hard, clean, vitreous clinker free from sulphides, unburned coal and ashes. Clean cinders will not discolor the palms of the hands when rubbed between them.

The Selection of Dust Preventives*

THERE are many factors to be taken into consideration in selecting a proper dust preventive, chief among them being the type of road under consideration, the condition of its surface, the character of the traffic and the standard of living of the community, as well as the amount of money available. Although the method employed under one set of conditions might be entirely unsuitable for another, in a general way it is possible to obtain satisfactory results by the careful selection of materials.

Pavements.—Inquiries have been received by the State Highway Department as to the method of laying the dust on a brick street, and the advice has been to "clean it." Attempts have been made to apply oil and various preparations for retaining the dust on such pavements, but such methods are to be condemned. The only satisfactory way to keep brick, asphalt, wood block and concrete pavements clean and dustless is to sprinkle and sweep them, or in some cases, flush them with water under pressure. There will ordinarily be no dust nuisance on such pavements built in rural districts with sunken curbs, as the rain water will keep them clean.

Suburban Roads.—The suburban stone road offers the widest choice of methods of dust suppression, the choice depending largely upon the degree of permanency desired. For the most lasting results, either the heavier tars or asphaltic oils may be used, while for less lasting results the choice lies between the lighter oils or tars, the emulsions, calcium chloride and various patented preparations. If there are hydrants at convenient intervals along the road, salt solutions or emulsions may be used. If an emulsion is to be used, that product containing the greatest amount of binding base per unit cost should be selected, unless it possesses some other quality such as a strong, disagreeable odor which makes it undesirable. While, as stated, the selection of the material must be governed by local conditions, it is believed that in most cases the more permanent methods of dust suppression will be the more desirable.

Park Roads and Race Courses.—These are considered together not necessarily because of a similarity in type, but because the temporary binders are especially suited to both types. On such roads the traffic conditions are considerably different than on other types. In the case of a speedway, the use in general is limited to a very short time, while traffic on park roads is chiefly confined to the summer months. It is, therefore, obvious that in many cases the best economy would not be obtained by the use of the more permanent dust preventives. A treatment of calcium chloride has proven very satisfactory for race courses; and for park and similar roads, subjected to traffic for a longer time, oil and tar emulsions have been used advantageously.

Rural Roads.—The number of methods of dust prevention to select from for roads of this class is much more limited than in the case of suburban roads. It is apparent that the temporary treatments are not applicable to most country roads for the reason that a convenient water supply, required for the use of the oil emusions and salt solutions, is not available. Rural roads may be classified as hard roads and soft roads, hard roads including brick, concrete and macadam and soft roads including gravel and earth, the gravel sometimes being worthy of a place in the first classification. The material to be selected will depend upon the kind of road to be treated. Brick and concrete roads will be maintained in a comparatively dustless condition by rain water and need not be considered further. The most satisfactory method of treating macadam is by a surface treatment of hot asphaltic oil or refined tar covered with gravel, slag or stone chips. Other things being equal, this method is recommended in preference to cold treatments with lighter oils and tars, for although these are applied at a much less cost the results are not so lasting. If, however, the road cannot be cleaned so as to expose the large stones in the surface the lighter oils and tars are likely to give the better results. Provided both are of suitable grade and of good quality, there is not much preference between oil and tar of this class of work. A good tar is preferable to a greasy paraffin oil, and a good asphaltic oil is far better than a poorly prepared or high temperature tar. Gravel roads have been treated with both oil and tar, but more generally with the former. In the case of a good, hard gravel road, practically the same treatment as recommended for macadam may be applied. The cold surface treatment has been used to a greater extent than the hot treatment for this type of road, and Glutrin has also been used to some extent.

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*Abstract of a section of "Dust Prevention," Bulletin No. 27. Ohio State Highway Department.

It may be said in conclusion that it is essential to give careful consideration to all local conditions governing the selection of proper material and the proper method of application. Care must also be taken to secure good quality in the material which is selected, which means that the material should be examined and tested. It is also important that the treatment should be renewed as soon as the condition of the road demands it, if it is desired to maintain the road in good condition and free from dust.

Quebec Bridge Anchor Arm Diagonal and Posts

Description of Largest Web Members of 515-Foot Trusses, Which are Erected in Several Units

THE principal web members of the 515-ft. anchor arm trusses of the Quebec Bridge are all of unusual length and weight, reaching or approaching the limits of transportation and, whether for compression or tension stresses, are of rivetted construction. Most of them are designed with four webs of built channel or I-beam section which are strengthened by longitudinal and transverse diaphragms, the flanges being connected by tie-plates and latticing. The largest intermediate post of all, L12-U12, and the two adjacent diagonal members M12-U14 and M12-L14 have four webs and are shipped and erected in halves. The tension diagonal M12-U14 is shipped and erected in halves which, after erection, are connected by three tie-plates, in order to keep the member as a whole in line. All pins are finished to an accuracy of 1/1000 in., pin holes being bored 1/32 in. + 1/100 in. larger than their pins.

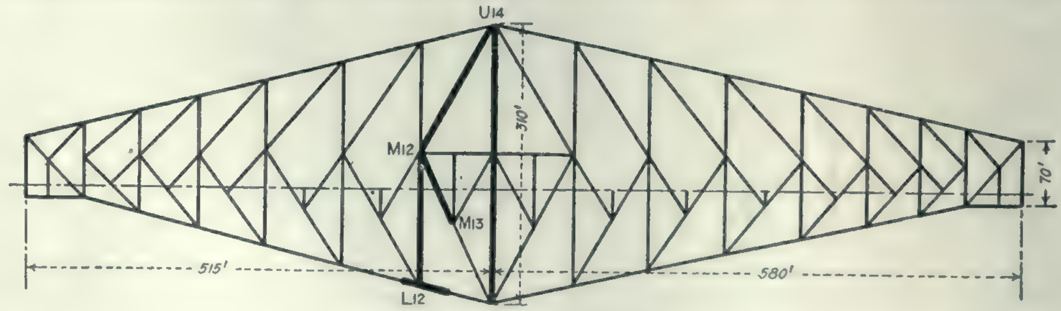
The diagonal M12-U14 is 154 ft. 11⅛ in. long over all, has a cross-sectional area of 391 sq. in., a total weight of 308,700 lbs. and is shipped and erected in halves. The webs are 48 ins. deep and 22 ins. apart, with their flanges turned in and latticed. The lower end is bored for a 16-in. pin and the upper end has a 16 x 18-in. hole providing a 2-in. adjustment to take care of any settlement of the falsework or deformation of the members under their own weight during erection. Each half of the member weighs 154,300 lbs. and will be shipped in two parts, but will be field rivetted before being erected.

Vertical Member L12-M12

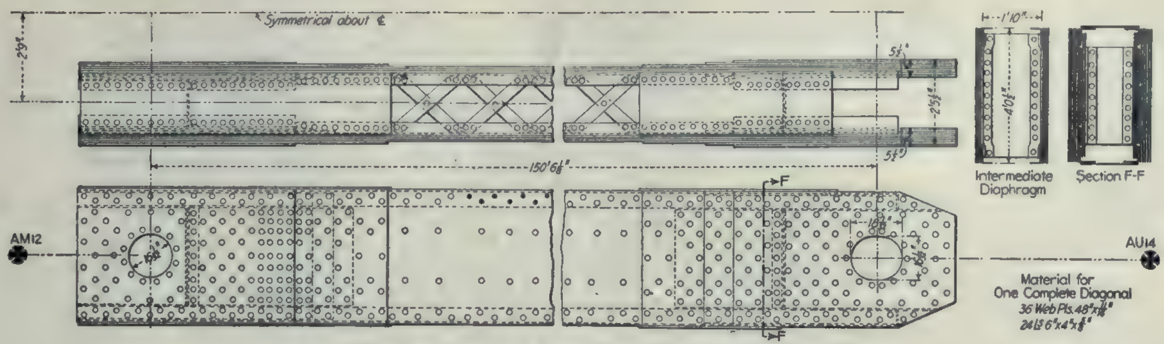
The lower half of L12-M12 of the vertical tension member at panel point 12, is 130 ft. 8 1/16 in. long over all, weighs 232,000 lbs. and has a cross-sectional area of 373 sq. ins. Each half is symmetrical about the axis and will be shipped separately and field rivetted together with idaphragms and tie-plates. The halves, 5½ ft. apart on centres, each have a 2 x 4-ft. rectangular cross-section made of two built channels with multiple plate webs, and have their flanges turned in and latticed with bars. The webs of each half are connected by transverse diaphragms at the ends and at four intermediate points. The tie-plates, nearly 12 ft. long, which connect the two halves of the member at an intermediate point, are bored for an 11-in. pin parallel to the bridge axis, which supports the floorbeams.

Diagonal M12-M13

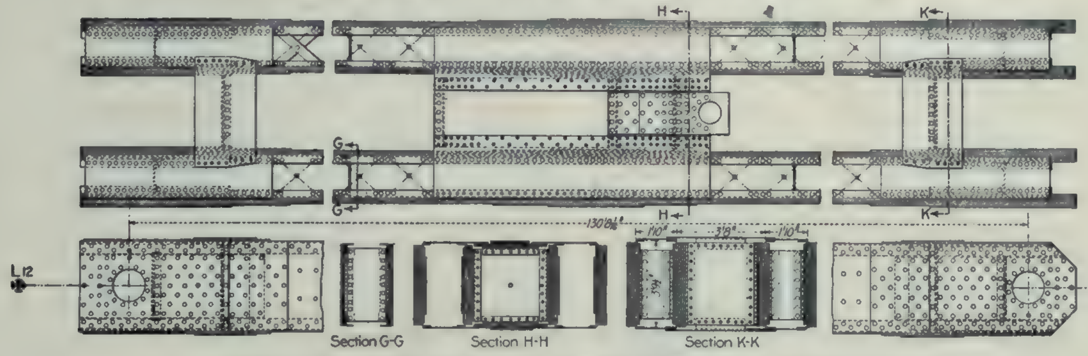
The upper portion of M12-M13, of the main compression diagonals M12-L14, is about 82 ft. long over all, weighs 295,000 lb. and has a cross-sectional area



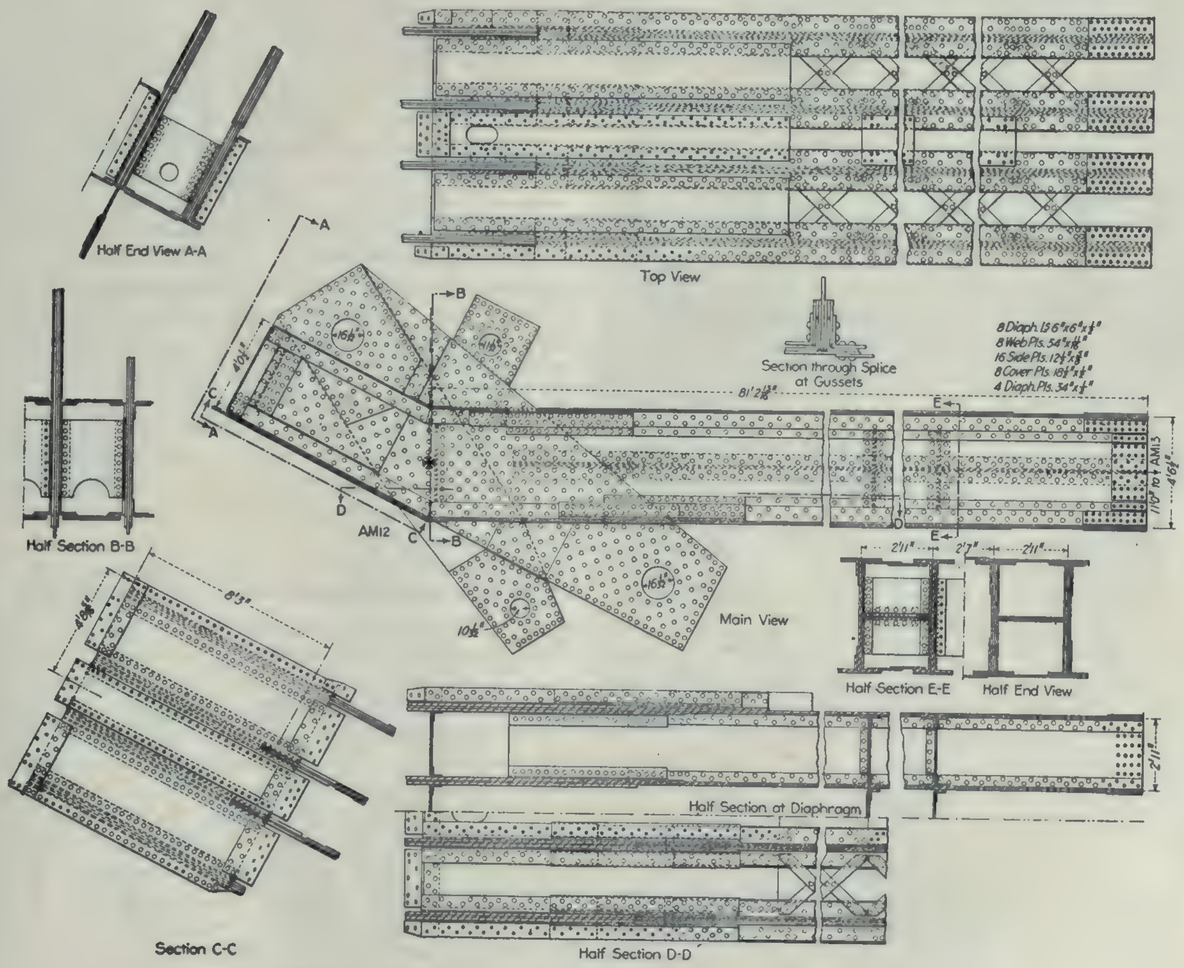
Location diagram of cantilever and anchor arms.



GENERAL ELEVATION OF MAIN TENSION DIAGONAL AM12-AU14



Details and field-rivetted splice of twin members of lower part of vertical post L12-M12.



Details of main compression diagonal member M12-M13, and of connections at upper end M12.

of 574 sq. in. The main body is symmetrical about the centre line, has four webs, and is shipped and erected in two halves. These duplicate sections are spaced 5½ ft. apart on centres and connected by field-rivetted flange tie plates. Each half member is made of a pair of built I-beams 4½ ft. deep and 2 ft. apart on centres with their flanges latticed. Their webs are also connected by transverse diaphragms and by tie-plates on the centre line.

At the lower ends the webs and flanges are spliced by field-rivetted flange and web splice plates to the lower part, M13-L14, of the same diagonal, and at the upper end four sets of reinforced gusset plates are shop rivetted to the webs and project beyond both flanges to receive the connection pins of the diagonal, horizontal and vertical members of the truss intersecting it at this point.

Main Vertical Post L14-U14

The main vertical post, 310 ft. high on centres, has a 9-ft. 2-in. by 9-ft. 10-in. cross-section with an area of 1,903 sq. ins. Including the eyebar connection detail at the top, and the detail at the lower end, which transmits the load to the pedestal, this post has a total weigh of 2,724,000 lbs. For convenience in fabrication, handling, shipping, and erection, it is made with twenty-six transverse and longitudinal field-rivetted splices. The middle section is 36½ ft. long and each of the other four intermediate sections 55 ft. long with maximum shipping weights of 120,000 lbs. each for the four pieces. The post is symmetrical about the longitudinal and transverse centre lines and each of the five intermediate sections is composed of four H-shape column sections connected to gether by field-rivetted latticing and tie plates. Each H-shape unit is 3½ ft. by 4½ ft. in cross-section and is made up of two built I-beam sections 3½ ft. deep.

Each of the four units in one of the intermediate sections of the posts has fourteen 8 x 8 x 13/16-in. flange angles, eight 19 x 9/16-in., two 19 x ⅝-in. flange plates and two 30 x 11/16-in. and six 37 x 11/16-in. web plates. The lattice bars are made of 8 x 13/16-in. and 8 x 11/16-in. bars.

In the short end sections of the posts the pairs of units are connected by wide cover plates parallel with the bridge axis, which engage both flanges of each unit. At the foot of the post the bearing is made with a 30-in. pin bushed to 45 in. but in the upper end detail, which alone is made of nickel steel, the bushing is eliminated and connection is made by a 30-in. pin to a rivetted nickel steel link bored also for the pins for four separate sets of top chord eyebars and for the pins for two diagonal members.

The centre section of the post is provided with pairs of longitudinal gusset plates projecting beyond the flanges and bored to receive pin connection for sub-diagonal and horizontal truss members in both the anchor and cantilever arms. The horizontal longitudinal strut connected to the post at this point is provided with a telescopic adjustment to permit the post to be erected in a temporary position 15 ins. out of plumb at the top and afterwards to be moved into a vertical line.

All concrete specifications for important structures should definitely require that the sand shall be actually tested in a laboratory with the brand of cement to be used in the structure, and shall be rejected if it does not reach the standard strength in tension and compression.

Concrete Poles and the Possible Maximum Loads on Pole Lines

It is widely conceded among engineers who are confronted with the task of providing a suitable substitute for the present timber pole that the concrete product is the only practical solution of the problem. The two foremost points in which the concrete pole is superior to that of wood are the facts that a properly constructed concrete pole is practically everlasting, and that almost all such poles can be designed so as to make them much stronger and far more stable than the timber product. Aside from the actual strength of wires, the stability of all supports for electric conductors is the main factor which governs the length of wire spans, and inasmuch as the stability of concrete poles can be made greatly to exceed that of wooden poles, the fact is probably established that extremely long wire spans will accompany the advent of concrete poles for general use.

Many engineers have published figures representing the possible theoretical loads on pole lines, the main factor in all such calculations being an assumed violet wind pressure acting against ice-covered wires. In addition to this the assumption is also made, that the above conditions may be accompanied with a temperature of 10 deg. below zero, and that the consequent contraction of the wires might cause them all to break in the same span. It is claimed in this connection, under the above conditions, with the wind blowing in a direction parallel to the wires, that the maximum load occurs in this direction on the pole next adjacent to the broken span.

The foregoing conditions are apparently very uncalled for assumptions; statistics have shown that such a simultaneous combination of the elements is a very rare occurrence. No engineer attempts to figure any structure against an earthquake or a cyclone; still such calamities may occur in any locality, at any time and just as frequently as the foregoing combination of conditions. Viewing the situation from the standpoint of the purchaser who invests his money in the construction of pole lines, one must realize the vast importance of considering the interest on the increased capital which is necessary to make such work proof against conditions which so rarely occur.

Owing to the peculiar action of the catenary curve in horizontally suspended wires, a very slight movement of the wire at its point of attachment to the cross arm, will materially affect the sag at the centre of span, and it is unreasonable to conceive of any suitable attachment betwen the wire and the insulator, which will not allow such wire to slip, in case of breakage of wire, so that the sag will touch the ground at the centre of span and relieve the pole from about 50 per cent. of the extreme load against which it is usually figured.

The vertical load on any support for electric conductors is of little consequence as compared with the possible side pull in a horizontal direction at right angles to the wires. A properly designed concrete pole, therefore, should be widest at the ground line and tapering both ways therefrom; provided, however, that the bases of such poles are designed with sufficient area so as to support the combined weight of ice-covered wires. The width of the pole at the ground line should be made so as to resist the horizontal action of wind pressure blowing at the rate of 70 miles per hour, at right angles to wires covered with ½-in. of ice.

Many high tension transmission lines have been constructed with spans up to 1,200 ft. Such long spans are made possible through the use of steel towers with wide bases. There seems to be no authentic reason why trolley wires for electric railways should not be hung on longer spans than are now being used in connection with standard construction of such lines. The only apparent objection to long spans for such service is the sag in trolley wires which must be reduced to a minimum on account of the limited movement of the trolley pole. Through the use of the well known catenary suspension in which the trolley wire is supported from a messenger cable, the sag in trolley wires can be eliminated entirely, and the length of spans in such lines is governed only by the economical strength of the messenger cable. Owing to the possibility of cross-circuits being caused by the side sway in telegraph and telephone wires, the use of long spans in this connection has been questioned. It seems reasonable to believe, however, that this objection can be overcome through the use of insulators staggered alternately above and below the cross-arm, and while we believe that minimum increases in wire spans can be accomplished with telegraph and telephone lines, still there is really no authentic reason against the adoption of increased spans for all concrete pole lines which are erected for the support of electric conductors.

The development of concrete poles and the improved method of setting them result in extreme stability, greatly increased spans and a consequent reduction in first cost per mile, through the elimination of many poles, cross-arms, insulators, and labor. For example: An ordinary pole line using 50 30-ft. cedar poles per mile, set up with cross-arms and insulators attached, ready for wires, costs in this vicinity, about $650 per mile, with a probable life of 15 years and the possibility of renewing it entirely after every storm of any consequence. Substituting good concrete poles for this same service, using 30 30-ft. poles per mile, set up with all attachments ready for wires, the cost per mile will not exceed $600 and the line will last indefinitely.

In view of the above conditions, it does not require any great amount of forethought on the part of the conservative pole purchaser to realize that concrete poles will eventually not only solve one and all of his present pole troubles, but, that, in the long run a saving of many thousands of dollars can be effected through the elimination of constant maintenance, frequent renewals and unnecessary first cost of heavy construction.—Concrete-Cement Age.

Optimism from Sherbrooke

The City Engineer of Sherbrooke, Mr. Thos. Tremblay, sends the Contract Record and Engineering Review quite a cheering report on the status of business in that city. Conditions generally, he reports, are good. The machine shops and steel manufacturing plants are working on short time, but some manufacturing industries are benefiting by the war, having received large orders from the Government. The city is undertaking all the permanent work possible, with a view to maintaining employment. The works now in progress comprise a considerable amount of brick sewers and water mains. Concrete sidewalks are in course of construction on a number of streets. Next season's work will entail large expenditures, particularly in regard to the extension of sewer and water mains. Concrete sidewalks are in course of construction on a number of streets. Next season's work will entail large expenditures, particularly in regard to the extension of sewer and water mains. Mr. Tremblay refers to the possibility of a start being made on the trunk sewerage system, plans for which he is now preparing and which will cost perhaps $500,000. Paving and concrete sidewalk construction will probably mean an additional outlay of $150,000. The works carried out in Sherbrooke so far have been done on money raised by the issue of debentures more than a year ago, consequently no financial difficulties have been encountered so far.

Large New Picture House for Montreal

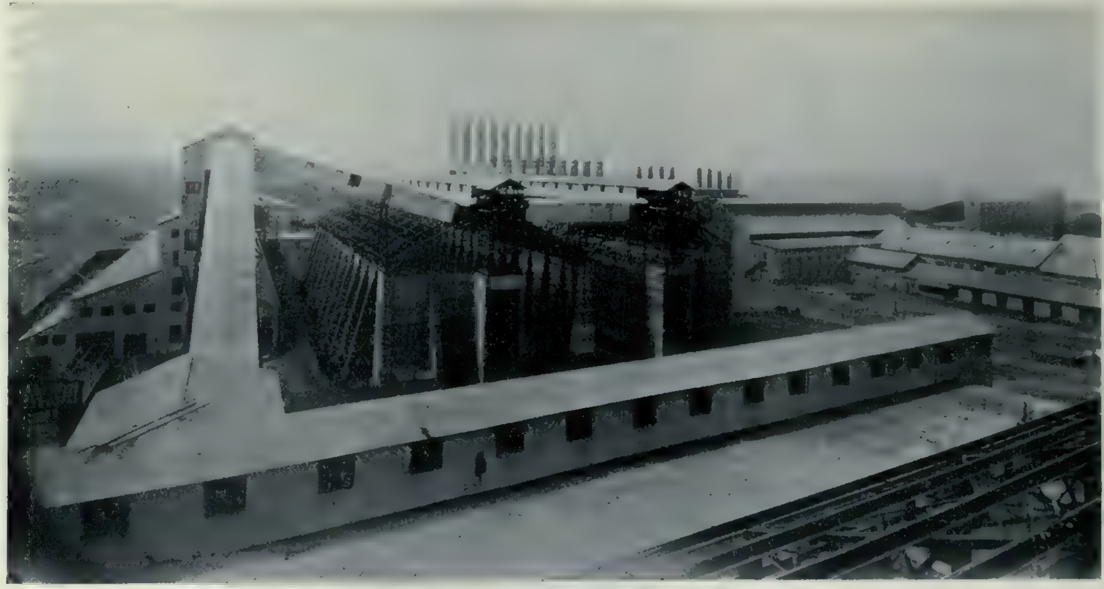
Messrs. Barott, Blackader and Webster, Montreal, (with Mr. A. E. Westover, Philadelphia, as consulting architect) have drawn up plans for a very large moving picture theatre, to be erected on St. Denis Street, between St. Catherine and Ontario Streets. The site is 120 x 195, and the theatre will provide accommodation for 3,000 people. The front section of the building will consist of floors of offices, while on the ground floor there will be accommodation for four stores. In addition to the auditorium, there will be a very large gallery, cantilever construction being employed so as to eliminate all columns and to give an interrupted view of the stage, which will be 33 feet deep. Exits will be provided on the four sides, enabling the theatre to be emptied in eight minutes. The building will be fireproof, and of steel and concrete construction. The exterior is to be of glazed terra cotta with a limestone base; the interior will be of plaster and imitation marble, the decorations being in the Adams style. The entrance will have an ornamental marquee. The ventilation system is to be by means of forced air, and the ventilating and heating apparatus will be located in the basement and under the stage. There will be a duplicate heating plant for use in the event of breakdown. Ventilating fans will be installed on the roof. To guard against fire, the cinematograph machines will be housed on the roof.

Proposed St. Denis Theatre, Montreal.

Arrangement and Operation of the Canada Cement Company's Plant No. 1

THE plants of the Canada Cement Company, Limited, are numbered from east to west, hence the plant described in this article, which is the farthest east, is designated as Plant No. 1. The original plant was built in 1907 by the Lakefield Portland Cement Company, and, together with Plants No. 2 to No. 10 inclusive, passed into the hands of the Canada Cement Company, Limited, in 1909. Since that time additional property has been acquired and extensive additions have been made to the plant, increasing its capacity from 1,200 barrels per day to a capacity of 12,000 barrels per day.

The property is situated about nine miles east of the centre of Montreal, on the north bank of the St. Lawrence River. At the foot of the company's property, the Harbour Commissioners of Montreal are now building a concrete dock five hundred feet long, which, when completed, will be leased to the company and will provide facilities for receiving coal on the site of the plant, and for shipping cement direct by water to the ports of the Maritime Provinces and the Great Lakes.



View of plant from top of Stock House No. 4 (during construction.)

The Canadian Northern Quebec Railway and the Montreal Terminal Railway (electric) cross the property. The former connects with all steam roads entering Montreal, and the latter permits of delivery to all parts of Montreal and its suburbs by street railway flat cars.

The plant is operated on the dry process, coal being used in the kilns. The raw materials are rock and clay, both of which are obtained close to the plant, but the composition of the rock is such that only a very small proportion of clay is required.

The plant is electrically operated throughout, all the larger machines having individual motors and the smaller ones being grouped. The power, which is purchased from the Montreal Light, Heat & Power Company, is delivered at 10,000 volts, 60 cycles, 3 phase, and is transformed to 550 volts for motors and 110 volts for lighting.

Water is supplied from the river by motor-driven turbine pumps. All departments are connected by telephone to the plant office, stores and electric substation. There are some six miles of railway track on the property, owned and maintained by the company, upon which both railways operate.

The original plant had a capacity of 1,200 barrels per day. This was first increased to 4,000 barrels, and later to 6,000 barrels per day. The original plant, together with these extensions, is now known as "Mill A." Before "Mill A" was completed a further extension was decided upon, and this extension, which was completed within the past year, is now known as "Mill B." It is arranged as a separate unit of 6,000 barrels capacity, but the kilns are placed alongside the kilns in "Mill A," forming one long kiln department, which is supplied with fuel from a single coal department. Three of the kilns in the centre of the department are arranged to receive their feed from and to discharge their clinker to either mill, for the purpose of balancing operations. The raw and clinker grinding departments in "Mill B" are combined in a single unit, and the machines are so arranged that part of them can be used for grinding either raw material or clinker, as required.

The block plan reproduced herewith shows the general arrangement of the plant, its division into mills "A" and "B" and the sequence of operations.

The quarry, which is immediately adjacent to the mill, is at present worked to a depth of about 55 feet. Most of the drilling is done by electrically-operated well drills, but air drills are used on some of the lower benches and for sinking purposes. Three 75-ton steam shovels load rock into standard gauge side-dump cars, which are pulled up inclines to the crushers by electric hoists.

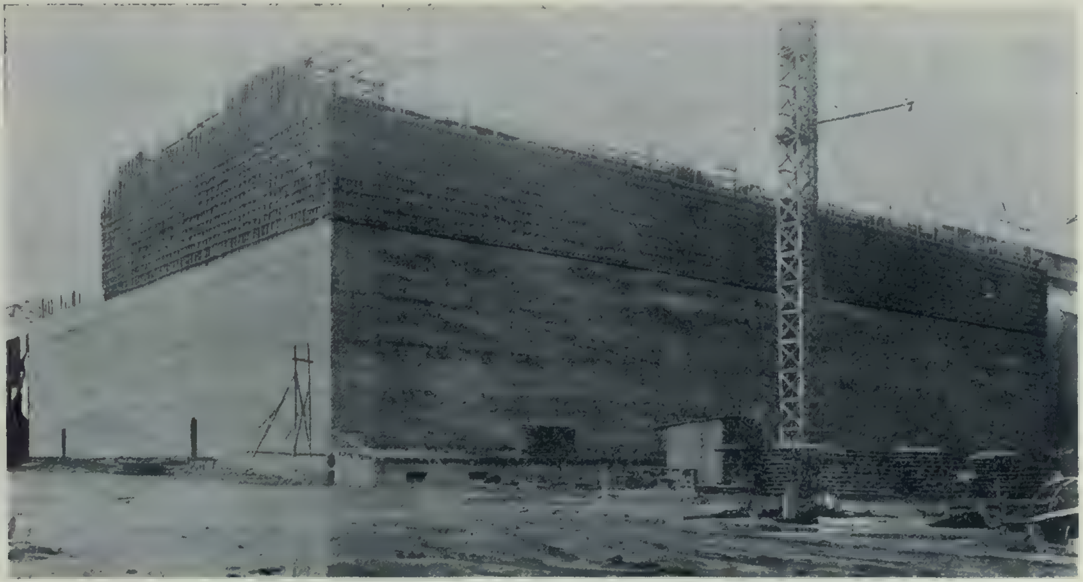
Rock Crushing, Storage and Drying.—In "Mill A"

Kominuters and Tube Mills in Grinding Department, Mill B (during construction).

the crusher equipment consists of a No. 11 gyratory crusher, followed by two pairs of 54-in. x 24-in. crushing rolls. The crushed rock is delivered by two 24-in. bucket conveyors either to storage or to bins over three 6 ft. x 100 ft. dryers.

In "Mill B" the first crushing is done by a 36-in. x 60-in. Fairmount crusher, which discharges into a 60-in. inclined pan conveyor. This conveyor discharges into a 7 ft. x 19 ft. rotary screen with 2¾-in. perforations. The tailings are fed to three No. 6 gyratory crushers, the product of which, together with the "fines" from the screen, is delivered to two bucket conveyors, which carry the rock to large concrete bins back of and above the dryers. The capacity of these bins is sufficient for two days' run. This dryer department contains nine 7 ft. 6-in. x 60-in. rotary dryers, each of which is installed directly back of a 9½-ft. x 150-ft. kiln, in such a way that the heat of the gases from the kilns is utilized in the dryers. The dryers discharge the rock into two bucket conveyors, which carry it to the raw mixing department, from which a belt conveyor then carries it to the grinding department.

Kilns.—For convenience of inspection, the kiln department will be considered before passing to the new grinding department. The grinding department of "Mill A" will be dealt with later. The kiln equipment consists of four 8 ft. x 110 ft., four 8 ft. x 125 ft. and nine 9 ft. 6 in. x 150 ft. kilns. The first eight of these kilns operate in connection with "Mill A," and the last six with "Mill B." The three kilns in the middle, Nos. 9, 10 and 11, may receive raw material from



Stock House No 4 (during construction).

either "Mill A" or "Mill B," and discharge clinker to "Mill A" storage or to one of the bucket conveyors leading to "Mill B" storage.

Vertical coolers are used in connection with "Mill A" storage, but no coolers are provided for "Mill B" storage, as it has a capacity of 400,000 barrels of clinker, and is divided into two compartments, so that while hot clinker is being dumped into one, the cool clinker is being drawn from the other. Clinker is put into and taken out of all of the storages by means of bucket conveyors.

Grinding Department "Mill B."—This department contains both the raw and clinker grinding under one roof. The equipment consists of fifteen No. 85 kominuters and nineteen No. 18 tube mills in parallel rows. The feed bins are placed in a line between them, and the drives for the mills project through the walls into motor sheds on the outside. Five kominuters and five tube mills in the middle have their feed and discharge conveyors so arranged that they can be utilized on either material.

The rock and clay mixture is brought from the mixing department by belt conveyors, with a tripper for discharging into the kominuter bins. Clinker is brought from the bucket conveyors of the storage by a 24-in. belt conveyor to a mixing tower, where the gypsum is added. From the bins in the mixing tower a 24-in. belt with a tripper carries the clinker to the bins over the clinker grinding kominuters. This belt runs over a weightometer, giving a continuous record of the number of barrels ground.

The material from the kominuters is elevated and fed to the corresponding tube mills, from which the raw material is carried by a belt conveyor to the kiln department, and the finished cement by a belt conveyor to the stock house.

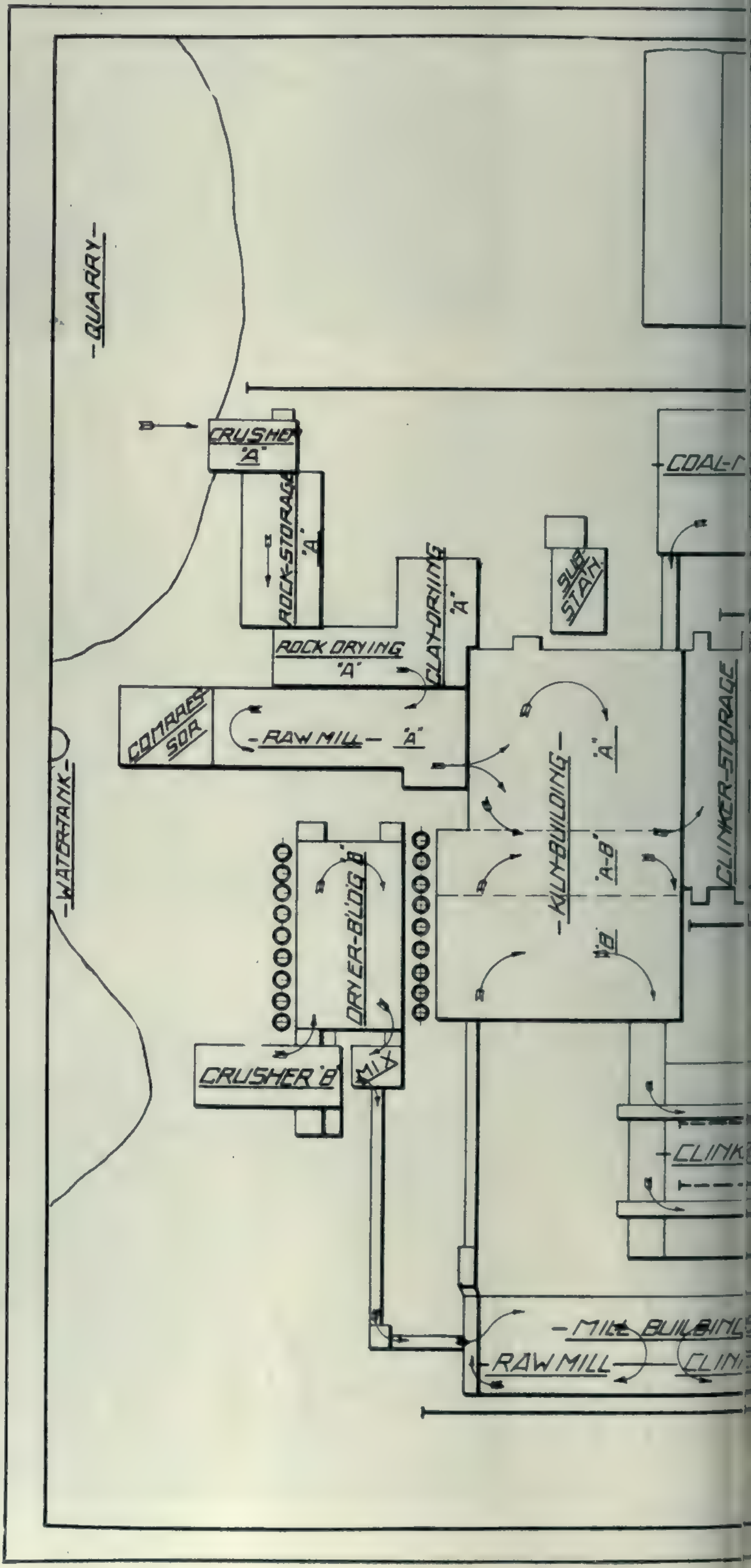
A gypsum storage with a capacity sufficient for five months' run is provided in connection with "Mill B." The gypsum is put into and taken out of this storage by an 18-in. bucket conveyor. In taking gypsum out of storage the bucket conveyor discharges on to a belt conveyor, which carries the gypsum to the mixing tower, where it is added to the clinker.

Stock Houses Nos. 3 to 6.—Owing to the long winter season, with its necessarily small demand for cement, the output for practically the entire year must be shipped in about seven months. This requires large storage and packing capacity. To meet these conditions, the company has evolved a type of stock house which is particularly satisfactory from the standpoints of convenience, capacity and design. Stock Houses Nos. 3, 4. 5 and 6 are of this type. They are 100 ft. x 200 ft. x 50 ft. high to top of walls, with the exception of No. 3, which was constructed first, and is only 40 ft. in height.

Each stock house is made up of a row of 20-ft. square bins around the four sides, enclosing a central storage 60 ft. x 160 ft. The walls are of reinforced concrete and the roof construction of steel. The bins are filled by a 24-in. belt conveyor with a tripper in the monitor. Cement is drawn out by 16-in. screw conveyors in cross tunnels beneath the floor, spaced 20 ft. centres. These discharge to a 30-in. belt conveyor, running longitudinally in an alley, just outside the foundation. Spouts in the floor, above the screw conveyors, allow for drawing from any of the small side bins or from the central storage. When filled to capacity, each stock house holds about 300,000 bbls.

Stock Houses Nos. 1 and 2.—Stock Houses Nos. 1 and 2 are of reinforced concrete with buttressed walls. They also have screw conveyors beneath, spaced 20 ft. centres, discharging to a belt along the front. Their capacity is about 120,000 bbls. each.

Distribution of Production.—The distribution of cement to these storages is as follows: "Mill A" discharges to Stock Houses Nos. 1 and 2 in one direction and to No. 3 in the other, by inclined belts. "Mill B" discharges by an inclined belt to Stock House No. 4

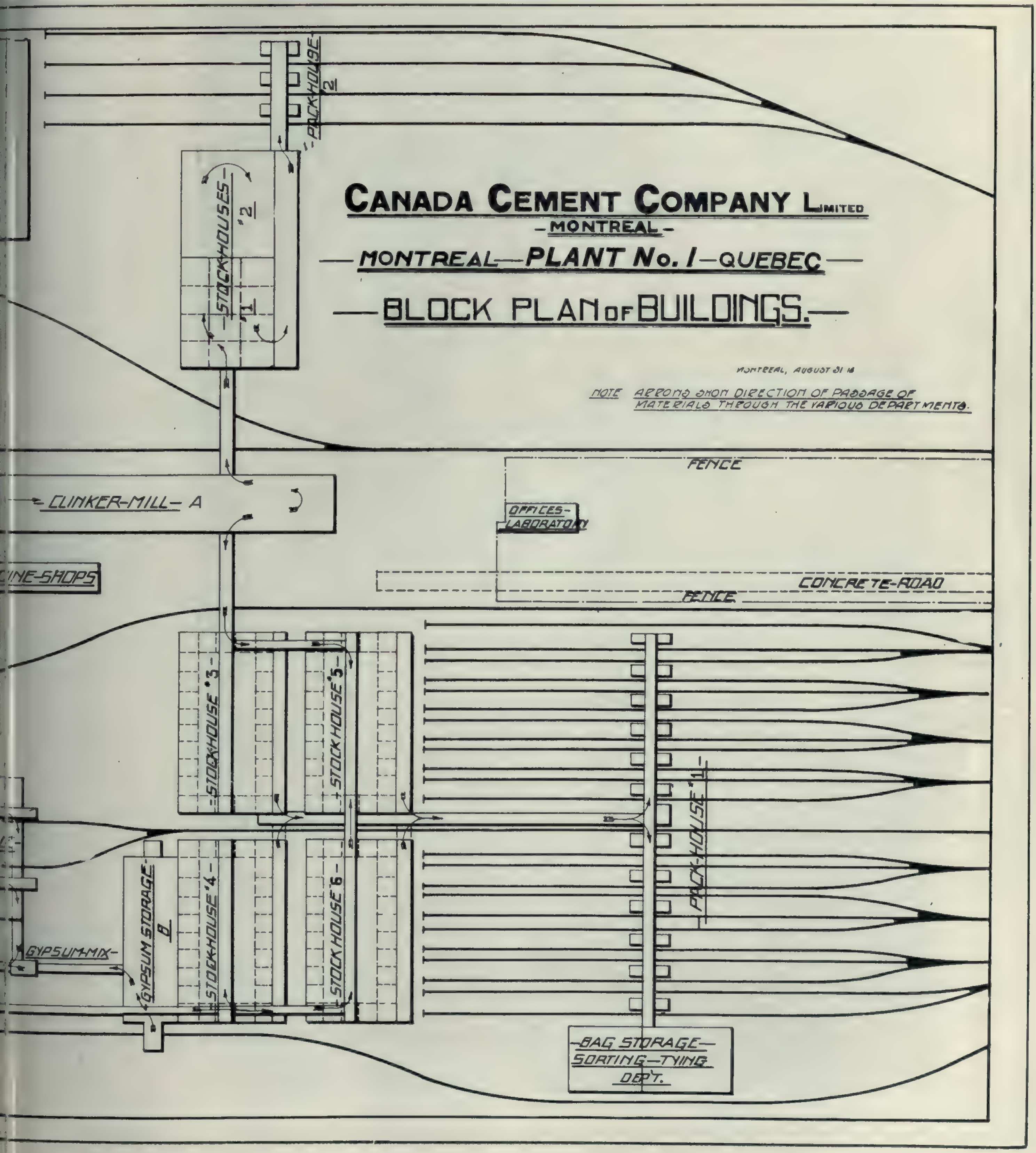


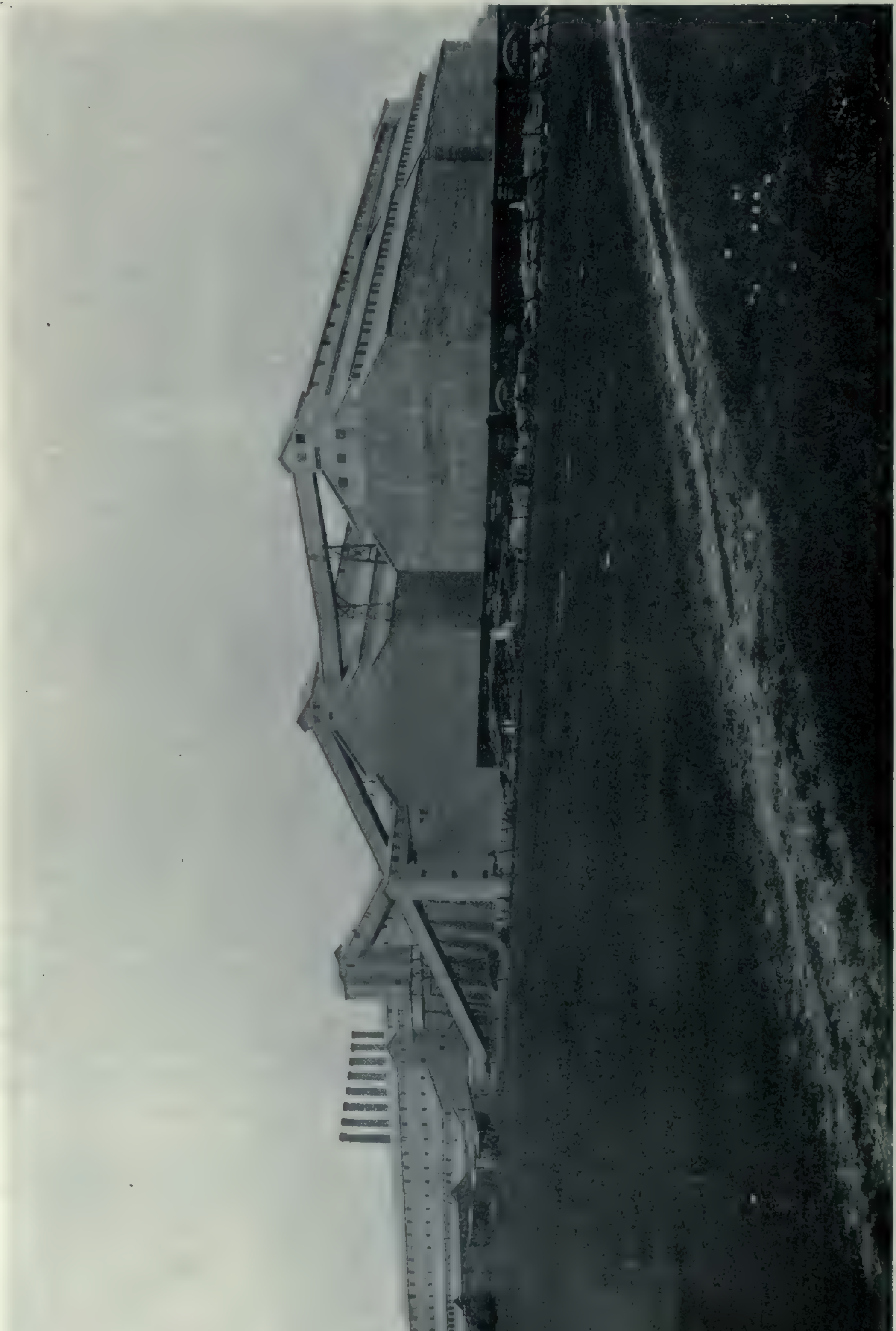
and by a transfer belt to No. 6. Both No. 3 and No. 6 can also transfer to No. 5 as an overflow from either "Mill A" or "Mill B."

Pack Houses.—The consideration of having to ship somewhat more than double the daily production, during certain periods of the summer season, requires an abnormal packing equipment. The present arrangement allows for the installing of twenty-four Bates machines in Pack House No. 1 and six in No. 2.

Pack House No. 1 draws cement from Stock Houses Nos. 3, 4, 5 and 6. The discharge belts of these deliver to either of two 36-in. inclined belts leading to the distributing tower in the middle of the pack house. The cement from each belt is passed through a rotary screen and on to another 36-in. belt, at right angles, filling the bins of one-half of the building.

The building consists of a series of packing sections. Each section is separated from its neighbor





General view of Plant No. 1, showing Stock Houses Nos. 3 to 6 in the foreground.

Pack House No. 1 and loading tracks.

by two railroad tracks running through at right angles to the building, but the conveyor portion is continuous over the whole. A double bin, in each section, supplies two Bates machines. The filled bags need to be trucked only a few feet to reach the cars on either side. This permits of using one machine to either track, two machines to one track or one machine to two tracks, depending upon delays due to the shunting of cars or repairs to machines.

The conveyor bridge has two floors. The upper floor is for the conveyor and the lower, a through runway, is used for distributing bags to the machines without interfering with machine operation or the shunting of cars. Beneath the buildings is a screw conveyor, in a tunnel, gathering the drip from the packing machines. This runs from both sides to an elevator in the central distributing tower. Here it is mixed with the incoming cement and again passed through the screens.

Bag Cleaning and Storage.—The Bag Cleaning and Storage Building connects with the distributing runway of Pack House No. 1 at its southern end. One portion has two floors. The lower floor is for the counting and cleaning of returned bags and is equipped with four large bag rumblers. The upper floor is for repairing and tying. Tied bags are bound together in bundles of 100 and placed in the storage section, so as to be available for the machines at any time. This has a capacity of about 2,000,000 tied bags.

Pack House No. 2.—Pack House No. 2 draws cement from Stock Houses No. 1 and No. 2 and is similar in construction to Pack House No. 1, except that it has only one track between each section. It is used largely for shipments by street railway.

Grinding Department, "Mill A."—Returning to "Mill A," the raw grinding equipment consists of 16 Bonnot pulverizers. Clinker grinding is done by 14 ball mills, followed by 16 tube mills. The clinker

Coal Mill and Storage (during construction).

storage has a capacity of 100,000 bbls. and is served by two bucket conveyors. These conveyors carry both the clinker and the gypsum to large overhead bins, from which they are drawn in the proper proportions into a small car. The car is then hauled by an electric hoist and is discharged into the bins over the ball mills.

Coal Department.—The Coal Mill is located northeast of the Kiln Building and connected with it by a screw conveyor, running over the line of coal tanks in front of the kilns. Its equipment consists of six indirect driers, two kominuters, and six 5 ft. x 10 ft. tube mills. Beyond it is a large open storage. Two gravity elevators receive the coal from a track hopper, delivering either to the dryer bin belt or to a belt in the bridge over the storage. This bridge is 500 ft. long. A similar belt, in a tunnel beneath, returns the coal to the elevators, which discharge it to the dryer bin belt.

Coal Unloading Dock.—The dock now under construction will be equipped with an electrically-operated coal unloading bridge over 400 ft. long, having a handling capacity of 200 tons per hour, and providing a storage for 200,000 tons. The same machinery will reclaim from storage and load into cars for haulage to the plant.

Laboratories and Shops.—Fully equipped laboratories occupy a portion of the Office Building, in which continuous tests are made of the raw materials and finished cement. The Stores are located just east of Clinker Storage "A." Adjoining them are the Machine Shop and Blacksmith Shop. These, together with the Carpenter Shop, make it possible to do all ordinary repair work promptly.

Cement In Lumber Dry-Kilns

Concrete Provides Efficient Insulation Against Radiation or Other Heat Losses, as Well as Against Entrance of Moisture

By G. D. Crain, Jr

WHEREVER tightness against both moisture and air is desired, the use of concrete has become practically a foregone conclusion in recent years. Conspicuous examples in proof of this are found in the use of reinforced concrete for the construction of grain bins and elevators and other such necessarily moisture-proof structures.

A somewhat inconspicuous, but nevertheless important, illustration of the same valuable properties of concrete is found in the use made of it in constructing the dry-kilns now generally employed in all of the larger establishments that must use lumber in their operations. These kilns, the purpose of which is to remove by artificial means the moisture from green lumber, should, of course, be perfectly tight, in order to secure the best results; and experience has shown designers of such structures, and wood users generally, that the liberal use of concrete is the best way to do this.

A dry-kiln built for a Louisville wagon manufacturing concern in 1906 is as interesting a piece of work as can be found. Its relatively long period of use is also of interest as demonstrating the efficiency and durability of the kiln.

This wagon company uses large quantities of lumber, principally oak and hickory; and inasmuch as it is highly desirable, if not essential, to keep the plan in practically uniform operation as much of the time as possible, a large and efficient dry-kiln was needed to make certain that there would always be on hand an ample supply of well-cured material. In certain seasons the natural supply of air-dried material is frequently very short; and as it takes about four years for a 4 by 4 stick of hardwood to season in the yard, the advantage of an efficient dry-kiln is obvious as a means of hastening operations.

The requirements of a dry-kiln being as indicated, the use of a material which would prevent the radiation or other loss of the heat introduced was obviously necessary; and for this purpose the contractor hit upon concrete in conjunction with hollow fireproof tile—a combination that eliminates the otherwise almost constant danger of fire in such structures.

A rather odd situation controlled the design of this dry-kiln as to the method of drying, which provides for the use of two distinct processes—one as steam radiation system, as used in the "Andrews" type of condenser kilns; and the other, a hot-air blast, this being known among lumbermen as the "common-sense" kiln. The company had not fully satisfied itself as to which method was most efficient, and therefore decided to make arrangements to use both.

The building measures 101 ft. long by 91 ft. 6 in. wide; and in order to enable the two systems to be used side by side, the yard track carrying the cars of lumber into the kiln was run between two separate sections, one of which contained the blast system, and the other the steam radiation system. The former consists of a series of six chambers of about equal width, but of only half the depth of a similar series on the other side, in which the steam is used.

In order to prevent moisture creeping in from below, or heat escaping in that direction, concrete floors are used throughout the building, a slab about 5 in. thick, with a 1-in. top coat, being used.

The two systems calling for different systems of placing the lumber, the construction plans of the two sides were also necessarily different. The most conspicuous difference, perhaps, lies in the height of the floors themselves. The tracks in the several chambers are necessarily higher than the track entering the building, the method of handling the lumber being to bring in a loaded truck from the yard, set sidewise on another truck, so that it can be rolled off onto the track in the chamber in which the lumber is to be dried. No turntable is necessary, the tracks in the drying chambers running at right angles to the track entering the building.

In the hot-blast side, the hot air being forced through the several chambers by a fan and suction system, which carries the air through at one side and back by the other, it is not desirable for the lumber to be much elevated; and the floor is therefore raised to the level at which the car must enter these chambers from the track from the yard. The concrete floor in this side of the building, therefore, rests upon a fill of cinders, which brings it up to the proper level.

On the other side of the building, however, the heat which effects the drying comes from 1-in. pipes running along the floor, and the lumber must be elevated above these. The floor proper, therefore, is flush with the floor on which the entering track runs, the tracks in the chambers on this side being supported on steel standards 3½ inches in diameter, which in turn are bolted to concrete piers. The tracks on the other side rest on dwarf concrete walls 12 inches thick.

The walls dividing the several drying chambers are composed of 8-in. hollow tile, coated on each side with an inch thickness of a cement mixture. The roof is a rather curious, but wholly effective affair, made up of several distinct layers of different materials, the rising tendency of heated air making it especially necessary to provide against loss of heat at the top of the building.

Immediately above each chamber, constituting the inside ceiling finish, is a 2-in. thickness of a concrete mixture, applied as if it were plaster. The 4-in. thickness above this, constituting the roof structure proper, is of the ordinary floor-plan used in many buildings, consisting of a series of ribs or beams, the spaces between these being filled with hollow tile. These beams run at right angles to the walls, and derive part of their support from them.

On top of this roof-slab of concrete and tile, a thick layer of cinders is used, ranging from about 6 in. at the edge to twice that, according to the pitch of the roof. This in turn is covered with composition roofing, making a quadruplicate roof which has proved very efficient in keeping the heat in the building.

Patented doors and door-hangers are used at the entrances of the building, as well as to the several chambers, set in concrete frames to prevent the outside temperature from affecting the drying process. The careful separation of the drying chambers from the passage on which the entering track runs is particularly necessary, in view of the fact that this passage is lighted from above by means of skylights, and it is difficult so to adjust ordinary skylights so as to make them air-tight. In this case, accordingly, the lights rest on concrete frames.

Heat for the hot-blast sections, and steam for the other side of the drying plant, are furnished by the power plant of the company, which is only about 100 feet distant. Both are conveyed overhead by means of asbestos-covered pipes. Exhaust steam is used during the day, live steam being provided at night when there is any lumber drying.

The dry-kiln has proved completely satisfactory to the company, handling very efficiently all of the lumber which has to be dried; and, it may be remarked, the company has not yet fully decided which drying system it prefers.—**Cement World.**

In connection with the walls of a brick building it was desired to clean and brighten the terra cotta trimming, the bricks being of a deep tan color, while the terra cotta was of a light cream that had turned dark and was unsightly from many years' exposure. In answer to this question by a correspondent of the Painters Magazine, the latter furnishes the following: The simplest way to accomplish this is to mix two pounds of powdered pumice and one pint of liquid ammonia with one gallon of soft soap, applying the mixture to the surface to be cleaned with a fibre wall brush, allowing it to remain about thirty minutes. Then rub briskly with a good scrubbing brush. When on trial it shows that the compound has done its work, clean it off with lukewarm water by using a large sponge and rinse, if possible, with a hose, otherwise with the sponge and a liberal supply of clear water. If after drying the terra cotta appears dull, it may be revived by rubbing it over with a cloth saturated with kerosene oil, which will give it somewhat of a "sheen."

Unprecedented Trussed Spans

DESIGNS and estimates for a $75,000,000 high level bridge across San Francisco Bay have been prepared by Charles E. Fowler, according to the Engineering Record. They include terminal structures at both ends, a 20,000-ft. approach and 800-ft. cantilever spans at one end and a 9,700-ft. five-span $49,000,000 crossing from Telegraph Hill to Goat Island. The important features outlined in the general design presented include beside the unprecedented dimensions, the general outlines of the trusses, the character of the sub-structure and the details of main pedestals and compression chords for the cantilever arms.

The bridge is designed for a capacity of 60,000,000 people and 56,000,000 tons of freight annually, and is proportioned for two steam railway tracks, two electric car tracks, and two 20-ft. roadways giving an assumed loading at 18,000 lbs. per linear foot. The cantilever structure, symmetrical about the centre point, has a clearance of 150 ft. above high tide and has three 2,000-ft. spans, four 250-ft. intermediate towers and two 1,350-ft. shore spans. The main spans have 650-ft. cantilever arms and 700-ft. suspended trusses, while the end spans have 650-ft. cantilever arms and 700-ft. trusses connected to them at one end and supported on the abutments at the other end. The depth of the trusses vary from 75 to 450 ft. and the horizontal distance between them varies from 65 ft. in the clear at the centre to 126 ft. at the towers. The trusses have 100-ft. panels with single diagonals and curved top and bottom chords.

The cantilever bottom chords are octagonal tubes 14 ft. in outside diameter made up of eight sets of three built I-beams 18 ins. deep with outside and inside flange cover plates forming the interior and exterior surfaces of the tubes. They are stiffened by solid web transverse diaphragms reinforced by heavy vertical horizontal and flange angles. A typical section is built up of 1¾ x 70, 1¾ x 54, 1½ x 50, 1 x 26, 1½ x 21 and 1 x 18-in. plates, and ninety-six 6 x 6 x ¾-in. flange angles, giving a total cross-sectional area of 3,602 sq. ins.

Each of the four vertical posts of each tower will have a built up shoe planed to a long radius bearing to provide adjustment for deflections in the span. Nickel steel will be used for the suspended spans and for long tension members in the cantilever arms. The concrete piers with very deep foundations will be frustrums of cones providing extended footings to secure sufficient bearing and having granite tops 35 ft. high to distribute the loads over the concrete. It is assumed that the bridge can be completed in about ten years.

Proper provision should be made in concrete construction for temperature changes either by reinforcement or by expansion joints.

Permissible Pollution in Raw Water to be Filtered for Domestic Consumption*

By Geo. W. Fuller, New York City

WHILE for some years this question of the proper loading or burden on filters has been considered in many places and attempts have been made to fix some sort of a standard which would serve the purpose, these attempts have met with very little success. The difficulties of fixing such a standard are self-evident. It is rather obvious that no exact relationship exists between the sanitary quality of the water and the number of bacteria present, no matter how the bacteria are tested, whether in the form of total bacteria or some special form such as the colon bacillus. It is possible that some waters should have good sanitary properties and yet have a rather large number of bacteria. Other waters, again, which might be relatively free from bacteria, would show themselves to be unhealthful.

While it has been clearly recognized that some limits, definite if possible, should be placed on the proper burden for filter plants, no such limit has, until recent times, been established.

B. Coli as a Basis of Determination

The first question that arises for determination is, How shall the quality of a water be measured or determined? For bacterial purposes, bacteria have been taken in various ways, measuring the total number of bacteria either at 20 deg. Centigrade or 37 deg. Centigrade on various media. Then, again, special bacteria, such as the B. coli, may be considered a better indication of the fecal pollution than total bacteria. In some extreme cases experiments have suggested the taking of the actual determination of disease bacteria, such as the typhoid bacillus or the cholera bacillus, as a guide to the true disease-carrying sources of pollution. Each of these methods has some advantages and some disadvantages.

Considering the last, the direct determination of disease-producing bacteria, this is practically ruled out by the difficulty of making such determinations. It has not yet been generally feasible to determine with precision and certainty whether bacteria such as the typhoid are present in any water, and while such determination is sometimes successful it has not been generally so. In addition, we are not quite sure as to the limitations of water-borne diseases to any specific small number of kinds, and it would be quite possible that even exact and positive exclusion of a certain small number of organisms would not be a guarantee that the water could not contain some other disease-producing bacillus which has not yet definitely been determined as such.

The determination of the total number of bacteria present has been the simplest and most common form of water analysis procedure, and has considerable value. The old standard of the German sanitarians was an allowance of 100 bacteria per cubic centimeter in filtered water. This standard is a simple and in some ways a useful one, and has been widely extended in this country. Assuming a bacterial efficiency of the filters at 98 per cent., the raw water to give such a filtered water should not exceed a bacterial content of 5,000 per cubic centimeter.

The objection may be raised that by far the greater number of bacteria are simply water bacteria or non-pathogenic, and are no indication either of pollution or of having any harmful effect. A water may have a very large number of bacteria and still be absolutely harmless. This objection has been strong enough largely to discredit the total number of bacteria as being a very good evidence of the wholesomeness or unwholesomeness of any particular water.

The third determination, that of B. coli, has come to be recognized as the most satisfactory, all things considered, of the possible methods of determining the pollution of a water. B. coli of itself is not, of course, any direct indicator of disease-bearing bacilli. It is only a very indirect evidence of the possibility of recent fecal pollution. As is well known, B. coli originates from many other sources than human fecal excrement. It is found in large quantities in animals, particularly domestic animals. It is also found in considerable quantities on grain materials and tilled fields. Water running off from farms, pastures, etc., must necessarily contain considerable quantities of such coli, and under such circumstances B. coli in no way show the evidence of dangerous pollution. Nevertheless, taking everything into account and knowing the limitations of the B. coli as an indicator of fecal pollution, it still must be said that this is the single best means we have of determining whether a water is most probably wholesome or unwholesome according to a number of B. coli present in the water. We recognize that this basis of determination is not at all conclusive or positive, but we also recognize that it is the best we have, and as such it is proper to make use of it in gauging the sanitary qualities of the water.

U. S. and Canadian Investigations

An International Joint Commission, composed in part of appointees of the United States and in part of appointees of Canada, has been investigating the question of pollution of the international boundary waters, with the idea of determining to what extent pollution must be limited in order not to endanger the health of the communities on the two sides of these boundary waters. As a great part, if not all, of the possible danger to health which must arise from drinking water, the question practically resolves itself into this:

Is it possible to maintain the water in such shape that without treatment it shall be suitable for drinking water?

2. If it is not possible to maintain the water in such a condition of purity and it does need filtration before being suitable for drinking water, what is the limit of pollution allowable before the filtration plant will be overloaded, and safe drinking water cannot reasonably be obtained by ordinary filtration?

The first source of information is those cities which have been receiving a supply of unfiltered water which have sufficient data available to show how this water stands in rank on the basis of B. coli present in the water. An examination of these B.

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*From a paper presented at the recent annual convention of the American Society of Municipal Improvements.

coli records and the records of the city, its typhoid data, to show whether this water can reasonably be classed as a fairly healthful and wholesome water or whether it should be classed as a water of rather deficient quality. A second source of information is the various filtered waters which are supplied to a number of communities and the records they have of coli content in this filtered water and the B. coli content in the raw water supplied to those filters. Most of our communities which do have filtered water show a satisfactory effluent and a satisfactory typhoid fever rate, which is some measure of the wholesomeness of the water supplied. An examination of the correspondingly raw waters applied to the filters gives some indication of where a reasonable standard limit should be placed. A third source of information is the consideration of a standard of efficiency of bacterial removal and the assumption of a reasonable number of B. coli in water supplied for drinking purposes and a corresponding calculation of what would be a proper natural limit of B. coli in the water supplied to the filters under these conditions.

On the basis of the information of these three classes must be fixed the required standard. This information, which is afforded, is by no means exact in character, and no exact reading can be made from it even in any particular case. Moreover, the data obtained from various cities are very conflicting, and even the data obtained at various times from the same cities under apparently similar conditions are conflicting and cannot always be reconciled. Some cities are receiving a markedly poor water in B. coli content, yet have a very satisfactory water from a sanitary standpoint, and typhoid fever rates are relatively low. Others, again, receive a rather good water and deliver for drinking purposes a decidedly good water and yet show a much less satisfactory typhoid fever rate.

It is recognized that typhoid fever originates only in part in water supplies, and that B. coli in the water and typhoid fever rates need not be in any relation to each other.

A case in point is that of the Birmingham, Ala., water supply. This city receives its water from two sources, namely, the Five-Mile Creek and the Cahaba River. The water from the Five-Mile Creek is sterilized after being filtered and shows practically no B. coli as delivered to the consumer. The water from the Cahaba River is filtered but not sterilized, and shows an appreciable amount of B. coli as delivered to the consumer. The water from the Cahaba River is filtered but not sterilized, and shows an appreciable amount of B. coli, though not an extraordinary number. Yet the typhoid fever of the two districts supplied from the two plants is no better in the first case than in the second. In the entire city the typhoid death rate is very low during the winter months but is high during the warmer season of the year, when fly transmission becomes a factor of importance.

The best that can be done with the data at hand is to consider all these data, properly weigh them, and on the basis of a rather general judgment come to some conclusion on what is a proper limit of B. coli in water to be applied to the filters. Such a conclusion can by no means be considered an exact judgment, and should be considered rather an average than a rigid limit for any particular case. This standard specifies that water applied to filters should show by the presumptive test not more than 500 B. coli per 100 c. c. of water as a yearly average, meaning by this that B. coli should not be found more than fifty per cent. of the time in 0.10 c. c. samples. For averages for shorter selected times, monthly, weekly, or daily, the allowable B. coli content may be considerably higher. It is believed that for this purpose the averages based on a year's readings are more useful than averages for a shorter time with a correspondingly different standard of allowable B. coli.

The adoption of a standard such as this means that, apart from pollution objectionable in other ways than bacterial, the allowable limit of bacterial pollution should be particularly measured by the condition of the water as it reaches the intake of some water supply where the water is purified. If this water shows no more than fifty per cent. positive tests for B. coli in 0.10 c. c. samples as a yearly average, the amount of bacterial pollution arising from a sewer outlet may be considered not too high. If, on the other hand, the bacterial standard so set is exceeded in the water supply, the need is set for the polluting community to purify its sewage by sterilization or further to such an extent that the water will not be affected to a more objectionable degree than the one allowed.

Local Conditions to be Studied Carefully

For any particular case to be considered special consideration must be given to the local conditions. If the water is such that practically all the B. coli can be attributed to sewage pollution, a rigid interpretation of the standard would properly be in order. In the case of a stream passing through farming communities where a large part of the B. coli does not originate directly from fecal excrement, but from fields, under such conditions that disease pollution would not follow, this standard can be more liberally applied. Other factors to be considered are the distance of the water supply intake from the source of pollution, the degree of dilution of the sewage effluent, the nature of wind and water currents, which may objectionably or favorably affect the movement of water to a water supply intake, and many other factors of this nature. While it is undoubted that a good deal of judgment must be used in special cases in applying any special standard of purity, and while such a standard cannot be used in ignorant hands as a substitute for expert supervision and expert judgment, a basis such as this is well worth establishing as a starting point for further investigations.

The bacterial efficiency of a filter is not an invariable quantity. Roughly speaking, 98 to 99 per cent. may be placed as a fair average under ordinary conditions. Percentages, however, are not always a good gauge of efficiency, as a water with an initial bacterial content that is high will show a proportionately higher efficiency in a filter than a water with a low bacterial content, and yet the resultant filtered water may be much less satisfactory to the consumer from a healthful standpoint than would be the case with the other filter with a lower bacterial efficiency.

With these conditions in mind, it seems reasonably safe to say that a water having in its raw form a coli content not exceeding 500 per each 100 c. c. based on yearly averages, will show in the water supplied to the consumers something not more than 5 to 10 B. coli per 100 c. c. Such water is believed to be a fairly safe water, when properly sterilized, for drinking purposes and for all other domestic uses.

Bituminous Surfaces for Concrete Roads

By W. H. Fulweiler in Concrete-Cement Age

THERE are three points which must be taken into consideration in order to secure satisfactory results. These refer to the condition of the concrete, the character of the bituminous material used and the method of application.

With reference to the condition of the concrete, many of the failures which have been attributed to the bituminous material have, in fact, been due to the formation of the thin film on the surface of the concrete of what I believe is now agreed to be a pectoid of the colloidal calcium silicates, which are formed by excessive trowelling or working of the wet mixture. This material does not adhere strongly to the concrete and it is readily broken off under the action of the traffic, so that the bituminous topping or surface when it rapidly peels away will be found coated on the under side and still in perfect adhesion to the thin white film which was the original surface of the concrete.

In order to avoid this, wherever we are in a position to control the laying of the material, we insist that the concrete shall be handled as little as possible, and we strongly deprecate trowelling and smoothing to obtain an even surface. We prefer that the concrete shall be simply struck off with a template, and further to prevent the formation of this "skin coat" we specify that just as soon as the concrete has taken its initial set, it shall be vigorously brushed with a stiff rattan or steel broom in order to break up any surface film.

With reference to the character of the bituminous materials, it will be appreciated that two qualities are essential:

First, that the material shall adhere perfectly to the concrete.

Second, that it shall possess sufficient binding qualities so that the bituminous concrete, if we may so call it, that is formed by its admixture with the stone chips shall possess sufficient cohesion to resist displacement by the traffic.

These two qualities may seem contradictory. The earlier experiments were made with material having a body or viscosity that was in the nature of a compromise, being in fact too heavy to secnre this necessary adhesion and too light to possess the necessary binding qualities.

This has led us to the use of two treatments, using different materials.

The first treatment consists of a very light application of a very thin material prepared by cutting back a heavy binder with a volatile distillate. This is, in fact, in the nature of a varnish. Since it possesses great fluidity, it penetrates the thin film of dust which always exists on the surface of concrete and in fact actually penetrates the surface of the concrete itself, to a depth of at least 1-16-in., the depth of such penetration varying with the character of the mixture and the handling it has received.

After exposure for about two hours the volatile cutback evaporates, leaving the heavy binder intimately incorporated with the upper surface of the road. In this manner perfect adhesion is secured.

We then cover this coat with our heavy binder, which possesses the necessary binding qualities to the fullest extent, since these do not have to be sacrificed to secure adhesion. In this way, we believe that we secure maximum efficiency.

In connection with the method of application, we believe that it is essential that the greatest care be used to sweep the surface of the concrete thoroughly, and remove all loose particles of stone, dust, etc., and especially exercise care in cleaning the depressions that inevitably occur in large surfaces, and are very difficult to sweep thoroughly, unless especial attention is given to them.

We apply the material from motor-driven pressure distributors, the pressure used being about 50 lbs. per sq. in.

To insure that the preliminary cold application should thoroughly penetrate the surface of the concrete, we are now recommending brooming this into the surface after its application with a power broom carried behind the distributor. By the use of such pressure distribution the balance of dust existing on the surface of the concrete is blown to one side, and the bituminous material comes into actual, physical contact with the concrete.

With reference to the mineral aggregate composing the bituminous surface, we have not sufficient data, as yet, to decide whether or not a thin coating applied at more frequent intervals would be more economical than a thick coating applied in the first instance and maintained with more or less frequent re-treatments.

We believe, however, that where there is very heavy traffic the thick coating will be found considerably more economical.

In explanation of the terms "thin coating" and "thick coating," I may briefly explain our specifications.

In "thin coating" the surface of the concrete is thoroughly swept, and 1-10. gal. per sq. yd. of our Ugite A is applied and broomed into the surface. This treatment is allowed to stand for about two hours, and 4-10 gal. per sq. yd. of our Ugite No. 3 is then applied at a temperature of 250 deg. F. and covered with from 35 lbs. to 40 lbs. of clean ½-in. stone chips per sq. yd., or clean, screened gravel of equivalent size.

For the heavy treatment or "thick coating," after the application of the 1-10 gal. per sq. yd. of our Ugite A, we apply 1-3 gal. per sq. yd. of the Ugite No. 3, and cover it with 40 lbs. per sq. yd. of stone chips, ¾-in. size.

A second application of 1-3 gal. per sq. yd. of the Ugite No. 3 is made, and covered with 30 lbs. to 35 lbs. of the clean ½-in. stone chips per sq. yd., or equivalent size of clean, screened gravel.

We believe that by the use of the ¾-in. stone we secure such an increase in the stability of the surface that it is not liable to displacement under traffic, especially the influence of heavy steel-tired vehicles.

Repairs on the natural cement floors of the 12,000,000-gal. storage reservoirs at Kansas City during 1913 were made necessary on account of the breaking through from one reservoir to the next under the walls. According to the latest annual report of Burton Lowther, chief engineer of the Water Department, the condition was obviated by driving 10-ft. steel sheet piling as a cut-off wall along the toe of the division wall. A 6-in. concrete floor was then placed over the entire floor and the heads of the piles were sealed over with a heavy slab of concrete made continuous with the floor. All slopes were repaired and cracks grouted. The work was carried on night and day by three shifts of fifty men, each working eight hours.

Liquids Used in Paints

By A. Ashmun Kelly

THE first in importance is linseed oil, for no other oil that may be used in paint commercially possesses as high a degree of excellence as this one. A paint film of this oil will not check, crack or blister after being applied, if properly applied to a proper surface. The oil flows well under the brush, spreads well, has enough body to hold up any ordinary pigment, and it does not run or become streaky. No other oil that may be used in common paint, that is to say, in paint used for structural work, will show these advantages. In brief, linseed oil is as nearly ideal for the purpose as seems possible. It has its defects of course. A few other oils have been used to take the place of linseed oil in paint, such as cotton seed oil, a very poor substitute, for it is not a drying oil; a very little of it in paint will show its character. Corn oil was some years ago used to some extent for putty making, and some of it got into paint, but it too is a poor drier, and at present its price takes it out of the class of linseed oil rivals. Soya bean oil is a semi-drying oil, and may be used in connection with linseed oil, but used by itself in paint it will not do, as it is another poor drier, not making as tough a film as linseed oil. Both poppy seed and hemp seed oil would do well as house paint oils, but their price is prohibitive. Paint mixed with poppy seed oil will not turn yellow in the dark as paint mixed with linseed oil does. Menhaden fish oil is an interesting oil to the painter; it will stand a great degree of heat, hence is useful in stack and boiler painting. It dries about the same as linseed oil, and produces a hard, waterproof film. China Wood Oil or Tung Oil is another oil of interest to painters, and it possesses some very curious characteristics. It dries very hard. It naturally dries very lustreless, which renders it useful in paints or in varnishes where a flat effect is desirable. The addition of as little as ten per cent. of rosin gives it a high gloss. While linseed oil dries from the surface, Tung oil dries uniformly throughout, and it is also the most rapid drying of all the drying oils. It is thicker than linseed oil, and is waterproof. It has no use in the paint shop, but the varnish maker can use it to good advantage.

Oils may be divided or classified according to their drying properties as follows, giving the principal oils of each class:

Drying Oils.—Linseed, walnut, tung, poppy, sunflower.

Semi-drying Oils.—Rape, fish, cotton, hemp, sesame, soya bean, maize or corn.

Non-drying Oils.—Olive, palm, castor, almond, cod liver.

Turpentine spirits made from the gum is the most important thinner next to linseed oil. While it thins oil paint perfectly it does not make it "short," it assists drying, prevents wrinkling, reduces the tendency of paint to become fatty, works well over damp wood, for it will absorb a certain amount of water. It is not affected by cold, withstanding a temperature of 30 deg. Fahr. without danger. It mixes readily with all paint oils and thinners, and may be mixed cold to any of the oil varnishes without causing separation of the gum. It is particularly liked for its flatting properties. Thin oil paint with benzine, and when the benzine evaporates the paint will have more or less gloss. Not so with turpentine. But it contains a certain acid that affects certain pigments, such as flake white and rose madder, changing their color within 24 hours after mixing. Turpentine made from stumps, etc., has the same qualities as pure gum turpentine, but the odor is different. Turpentine substitutes are made mostly from petroleum distillates. One of these distillates is water-white and is something between benzine and kerosene oil, but does not leave as much grease on white paper (a test) as kerosene does. While in most respects it is better than benzine for paints, yet it does retard drying somewhat.

Most turpentine substitutes are made from foreign petroleum oil, the American oil, while the best for illuminating oils is too light to make a good turpentine substitute. Russian "turpentines" are very greasy and do not evaporate well. It is truly remarkable how much like true turpentine spirit these substitutes smell, but this is explained by the fact that wood turpentine is added to give it that odor.

Benzine is a very active thinner of paint, and a great solvent of oils, but it possesses none of the best qualities of turpentine; it cannot take its place in painting. For instance, it acts too actively on the oil, removing too much of it, thus leaving the pigment with insufficient binder. It makes a paint short of grain, it does not level well nor give a good flat under the brush. It makes a soft paint. White paint thinned with it will yellow, which is not the case with turpentine. It does not work well in paint over damp wood. It will not mix with water.

Kerosene or coal oil, the former distilled from oil taken from the earth, the latter from coal, yet identical, is not a little used in painting. It mixes easily with oil paint, and painters like it for its easy flow and elasticity, and it is very repellant of water; but it is a very poor drier, not a self-drier at all, and only made to dry by the addition of considerable manganese driers. It is most used in the South and on the Pacific coast. In California it is used to almost the exclusion of turpentine. As far as my own experiments have gone, it is entirely unfit to use in structural painting.

Water is sometimes used in paint, both as a thinner and as an emulsifier. Water will not mix with oil unless in the presence of an alkali, or glycerine, or alcohol. Oil and alkali form a soap, oil and glycerine form a glyceride, while oil and alcohol form a mechanical mixture.—National Builder.

At a special general meeting of the Vancouver Builders' Exchange a committee was appointed for the purpose of making arrangements to co-operate with similar committees from other business associations in the city with a view to considering the question of trade conditions generally and the financial situation in particular. Mr. Hamilton-Lindsay, the secretary, states that manufacturers of material in the province have considerably reduced their prices. He suggested that the Dominion Premier should be approached on the question of the great need for change in the financial system of the country. The committee of the exchange are of opinion that it is high time the Government took a hand in the banking question instead of leaving it to the banks, as the Finance Minister had done. For some reason, it is held, the banks, instead of taking advantage of the offer of the Government, are apparently doing their utmost to strangle all legitimate business, in this section of the country. at any rate. Mr. Hamilton-Lindsay also states that the committee is of opinion that the National Association of Builders' Exchanges should take up this question with the Government.

"Going After" Business the Only Way to Get It

The Present is no Time to Rest on One's Oars—Business Lost Now will be Hard to Regain—Customers Gained Now will be Doubly Valuable When Trade Revives

By A. A. Briggs*

[Editorial note—In view of the fact that the Dunlop Tire & Rubber Goods Company, Limited, have decided to increase their advertising appropriation at the present time, this summary of conditions which influence national advertisers in making such a decision, will undoubtedly be read with great interest.]

Retrench—"To lessen, to abridge, to curtail"—that's what the dictionary especially calls it.

But hasn't the war so far shown that to retrench means particularly to **dig out a fresh trench,** to secure the means and the assistance to make a new assault on the enemy? In the latter interpretation we undoubtedly find what ought to be the keynote for the present advertising situation in Canada.

The truth is that on one side of the Dominion are ranged people who are following the dictionary's main stipulation of "retrench" for their publicity guidance. They may have reasons for so doing which no one in a different line of production can justly pass an opinion on; but it is also true that on the other side are ranged people who are leading—not following anything or anybody in their advertising policy which does not at once spell **Action.** It cannot be denied that the people who have decided "to lessen, to abridge, to curtail" their publicity are in the ascendancy at the present time. And everywhere the reason advanced is: "The War."

So far, from the standpoint of salesmanship, **no one has adduced a solitary economic reason why Canadian manufacturers who inaugurate advertising campaigns as a regular portion of their selling effort should discontinue that programme at the present time.** And, is it not strange that in all our mental hurrying to and fro, no one has yet proclaimed the fact that the war did not alter the Canadian consumer-purchasing market one iota? It must be understood that in making the above statement we are not dealing with any isolated cases where this particular business or that particular business may have been affected in countless ways other than the selling end. It is true, a manufacturer may have to pay more for his raw materials as one result of the war, but if he can get the materials at all, he always has the instrument of retail price-increase to wield in offsetting his losses, if necessary.

What really did alter the possibilities of the consumer purchasing field in Canada? Not the war, but the lull that antedated the war. A number of reasons precipitated the lull—most of which the public are conversant with. In other words; dull times, if one chooses to call them such, were here anyway—here in the sense that while the consumer was willing to a considerable extent to make purchases, the middleman had in many cases gone rather askew in his financing. The war simply accentuated the fast-spreading inclination to sit tight.

Naturally, during a portion of 1913 and most of 1914, manufacturers, in the main, were conservative in the matter of building extensions and such like, and sales efforts were always linked to due caution. This year, probably more than usual, attention was centred on the outcome of the Western wheat crop. That crop virtually has arrived, and, if reports are true, it is a good deal larger than advance estimates intimated. Then, notice the price per bushel paid for some wheat at the elevators. The farmers should now assist basic money circulation, which, of course, always commences the upward trend in the retail line.

In seeking out forces for advertising stimulus, it is one thing to deal with the possibilities of new fields of endeavor for Canadian manufacturers and another thing to explain away the measure of uncertainties attached to them. It cannot be gainsayed that consideration of new fields may mean consideration of bonuses and tariffs. What ought to be emphasized is that the Canadian manufacturer has, at least, as much area market as he had previous to the war and the general lull in consumer-buying conditions. Therefore, instead of risking new fields, which at best may be a costly experiment, the natural course seems to be that of again seeking the old field—**but seeking it ten times more forcibly.** This fact is brought home to us with double force when we have evidence aplenty that our friends to the South, in the widespread revival of the export propaganda, are considering the commercial blanketing in this country. It, therefore, behooves the Canadian manufacturer who has advertised in the past, not only to advertise again to create consumer demand for his wares, but to advertise as a means of actually holding what he already has. While suggestions are being made to flank some of the European countries' export business to Canada, we should not allow ourselves to be flanked in a commercial sense by our neighbors across the line.

Those advertising men who passed through the trade siege of 1907 and others before it—which sieges or lulls, or whatever you wish to call them, some bankers say cast their sly glances our way approximately every seven years—know well that **the manufacturers who assumed the defensive in publicity matters on those occasions had a difficult time regaining their stride when normal times returned.** That is natural law in the commercial world. There is no profit in manufacturing, no excuse for a factory's existence, unless the selling end is vigorous. The energy which keeps the selling end vigorous in abnormal times is identically the same energy which keeps it vigorous in normal times—only it is in abnormal times that keeping up the stride is fraught with more discouragements. One hundred courageous manufacturers and five hundred patriotic purchasing agents are worth more to Canada at the present moment than a million sermons or editorials on humaneness in war.

Realizing that one of the big sticks in the commencement of Canada's Comeback is to be wielded by the purchasing agent, every man occupying such a position in Canada, should have a creed something to this effect hung over his desk where he who runs in for an order may read:—

"I have hitched the firm's wagon to the Made-in-Canada star.

"I will specify on all purchases that Canadian materials must be used or the order will be subject to cancellation.

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*Advertising Manager Dunlop Tire & Rubber Goods Co., Limited.

"I know in so doing that I will thereby be encouraging the other fellow—whose traveller calls on me—to buy my firm's goods and possibly at a higher price, too, than he would have to pay for the foreign article."

Let us be assured that Canadian purchasing agents as a body have lined up behind the Made-in-Canada slogan, and we can expect to see Canadian advertising manufacturers assume the offensive. They will know that if they can secure a portion of the trade which formerly went out of the country, they can afford to write off certain business, the loss of which was consequent on a measure of consumer retrenchment. And let consumers see with their own eyes manufacturers' copy running in the papers and those self-same consumers—assured that the factory in which they are employed is going to keep running or the copy wouldn't be running—will commence again to make purchases with some measure of freedom.

Canadian manufacturers as a body must of necessity exist on Canadian orders; to the great majority "export" is an unused word. Orders will not be secured in dull times by methods that would fail in good times. One of the established beliefs of merchandizing is that properly-placed and properly-managed advertising is a force for facilitating sales. If this were not true, why would certain manufacturers—sixty per cent. of whose output might be styled luxuries—increase rather than decrease their advertising at this very moment?

They realize they have a big job on hand—that of securing orders when orders are unusually hard to secure. And they know full well that following the simple instinct of **going after business is the only solution** to the problem.

Considerations for the Designing Engineer

QUANTITY production is the basis upon which our tremendous manufacturing industry rests. The principle is so well understood that those who seek to increase the efficiency of plants generally start by attempting to reduce the number of models and designs. From the standpoint of costs the ideal plant is one in which only one device is produced and only one model and one size of that device. Sales considerations make this ideal impossible of attainment. Nevertheless, it is a cardinal tenet of economical manufacturing.

To some extent the principle is appreciated by designers and constructors of civil engineering works. They know, for example, that the cost of standard supplies is less than that of specials, and experienced men accordingly call for stock sizes whenever possible. This is chiefly true of steel shapes, sewer pipe and water pipe and fittings. When more complicated structures are involved the designers generally forget the principle and design "de novo."

For these structures there are no well recognized standards, and in designing them engineers are frequently guilty of the grossest extravagance. Ignorant or neglectful of construction considerations, they demand work of the most expensive sort, even when a certain amount of standardization, dispensing with individual designs for each particular case, would make their own work easier. It is impossible to account for the lack of such standards in any other ways than carelessness and ignorance of construction methods, or belief that the field man is trying to influence the designer improperly. Sometimes in his cock-suredness he takes the position that the king can do no wrong, he, of course, being the king.

It may be thought that these are idle generalizations, but every contractor can cite cases in which even the tyro in construction could have saved 10 per cent. of the cost of the job without any injury whatsoever to the structure. Two instances will show how, even on important work, there are losses, easily avoidable, because standardization and quantity production were not given adequate consideration.

The first is the case of a $100,000,000 project involving a large number of bridge structures. While the spans and loadings varied but little, there might be found on a single 5-mile contract six different designs of masonry. Piers and abutments, it is true, varied in height and sometimes, on account of the material encountered, in the footings. In practically no case was any part of the forms for one set of abutments and piers usable on another. It is conceivable that with similarity of span and loading it would have been possible to make at least the upper ends of all piers and abutments identical.

In another case, in the reconstruction of a large terminal, a tremendous number of concrete jack-arches were employed, being sprung between pairs of deep I-beams. Here would have been an excellent opportunity for standardization in spacing, making it possible to reuse time and again the forms for supporting the concrete. Instead, all sorts of variations were found, making it impossible to reuse the forms except in rare instances.

In both cases the total represented by the construction was very large and the opportunity for duplication correspondingly great. Nevertheless, it was apparent that the designers had little regard for construction considerations, and placed the theoretical above everything else.

Another instance, in which, however, it was possible to rectify the ignorance of the designer before serious damage was done, occurred on a drainage project in the Middle West. The original estimate for the cost of the work was about $550,000. Upon the completion of the design the owners called in consulting engineers and the latter saw immediately that the plant available for the construction of the ditches in question had not been in the mind of the designer. By relaying out the project so as to make it possible to use to best advantage the most economical type of equipment the cost was reduced 37½ per cent.

Primarily, of course, the designing engineers are responsible for this condition of affairs, but ultimately the blame must lie with the chief engineer or other official in charge of the engineering work. It is his business to see that the designers fully appreciate construction considerations and bear them constantly in mind.—Engineering Record.

A uniformly dense mixture of concrete should be the primary expedient to secure water-tight concrete. This may be supplemented by mixing with the concrete some form of waterproofing compound of proved efficiency or by washing the concrete surface therewith, or by both. Care must be taken in the selection of the waterproofing material and in determining the proper proportions and methods of application.

MAINLY CONSTRUCTIONAL

EAST and WEST — FROM COAST to COAST

At Saanich, B.C., the ratepayers have carried a by-law to raise $375,000 for the installation of a waterworks system.

The Montreal City Council have appropriated the sum of $100,000 for the construction of water mains this season.

The extension of Wilton Avenue, Toronto, is recommended, at a cost of $622,000. The recommendation is that of Mr. R. C. Harris, Works Commissioner.

The Ottawa City Council have authorized the City Engineer to take tenders for steel bridge of the bascule type on Pretoria Avenue. The estimated cost of the work is $120,000.

Saanich ratepayers have approved by-laws authorizing the expenditure of $450,000 on road improvements—paving and concrete. Mr. Hector S. Cowper is Secretary for the municipality.

The Road Department of the city of Ottawa has prepared plans and details for street grading involving an outlay of nearly $150,000. The work is under the supervision of Mr. F. C. Askwith.

Edmonton has received the assurance that Tramways, Limited, is prepared to proceed with the construction of the Interurban line as oson as arrangements are finally completed by the City Council.

S. Pearson. Son and Partners, Canada, Limited, a branch of the great English contracting firm, of which Lord Cowdry is the head, have opened an office at 705 Guarantee Building, Montreal. Mr. H. Japp is the manager.

The Midland Railway Company of Manitoba are completing a two-storey warehouse of pressed brick construction at Winnipeg at a cost of $125,000. The Sutherland Construction Company, Winnipeg, are the general contractors.

Excavating is about to be commenced on the new public library which is to be erected at Sherbrooke and Montcalm Streets, at a cost of $200,000. The architect is Mr. E. Payette, Montreal. The work will be carried out by day labor.

A contract for rebuilding the factory of the Bedford (P.Q.) Manufacturing Company has been let to Messrs. Gray and Smith, Montreal. The same firm will also build a dam on the Pike River for the purpose of generating power for the Bedford Manufacturing Company.

Excavations have been made for the new Commercial High School which is to be erected at Toronto for the Board of Education. The building is to be three storeys high, of reinforced concrete, steel and stone construction, containing 24 rooms. The cost is estimated at $260,000.

The new St. Dunstan's R. C. Cathedral at Charlottetown, P. E. I., the erection of which has entailed the expenditure of some $200,000, is nearing completion. The building is roofed and the interior work well advanced. The general contractors are John S. Metcalf Company, Montreal.

At Rosemount, a suburb of Montreal, a new school, estimated to cost $120,000, is being completed for the Protestant Board of School Commissioners. The architects are Messrs. Nobbs & Hyde, of Montreal, and the general contractors are Messrs. A. F. Byers & Company, Montreal.

Building operations are advancing rapidly on the new building which is being erected at St. Boniface by the Hospital Board. The architect is Mr. J. A. Senical, of St. Boniface, and the general contractors are Messrs. J. H. Tremblay & Company, Winnipeg. The cost is estimated at $300,000.

The new Central School at North Vancouver, erected at a cost of $120,000, is now nearing completion. The architect is Mr. W. C. F. Gillam and the general contractors W. J. Smith, Limited. both Vancouver firms. The building is of reinforced concrete and brick construction, fireproof throughout.

Contracts have been awarded for a new school building to be erected on Givens Street, Toronto, at a cost of $160,000. The largest contract, that for the masonry, was awarded last week to Albert Webb at $95,900. The building will be of steel and brick construction and will contain thirty-one rooms.

The rebuilding of the Bank of Toronto, Montreal, has been resumed. The work was interrupted owing to trouble with the foundations, but a contract for this portion is now being carried out by the Simplex Construction Company, Limited. The general contractors are the Atlas Construction Company.

At Toronto, operations have been resumed on the erection of the office building at the corner of Yonge and Albert Streets for Messrs. John Stark & Company. The work had been suspended temporarily. The building, which is to be six storeys high, of steel, terra cotta and brick construction, is to cost $100,000.

Foundation work has been commenced in connection with the new soap factory which Messrs. Proctor & Gamble are to erect at Burlington Street, Hamilton, at a cost of $1,000.000. Building No. 1, which will consist of three storeys and basement and which will cost $200,000, has now been started and plans will shortly be completed for building No. 2. In all there will be six buildings. The construction is steel, reinforced concrete and brick.

The Montreal Council are proceeding with the work of constructing the underground conduits, which it was previously decided to suspend owing to financial conditions. Arrangements have, however, now been made by which the Council are able to go on with the work. Invitations have been issued calling for tenders for constructing a further conduit, from the end of St. Lawrence Boulevard to the harbour front.

At Moose Jaw, Sask., it is not known definitely at this date what expenditures will be made on public works during the coming winter, but recently the city negotiated a loan of $500,000, and it is proposed to use a considerable portion of this sum in the construction of sewer and water mains during the fall and winter. Paving work will represent an outlay of $10,000 and extensions to the city power house $30,000. The City Engineer is Mr. Geo. D. Mackie.

Sir Lomer Gouin, Premier of Quebec, and Mr. J. A. Tessier, Minister of Roads. on October 12 formally opened a new concrete road seven miles long leading from Pont Viau through Cap St. Martin to St. Ross. The celebration took the form of an automobile tour of inspection by a large party of motorists on the invitation of the Provincial Department of Roads, by which the work has been carried out. Forty miles of good roads have now been constructed in

Ile Jesu. This represents an expenditure of $100,000 in Ile Jesu, exclusive of $40,000 expended in St. Rose itself, while in that portion of Laval County situated in the Island of Montreal, $200,000 is being expended on roads.

A still further extension of time has been granted to Mr. Norman C. McLeod, contractor for the Montreal filtration plant, the foundations of which were the subject of a very keen dispute between local engineers of repute. The city have agreed to a year's extension and to advance $50,000, also accepting the responsibility of $27,000 for wages. Mr. C. E. Deakin will be a sub-contractor under the new arrangement. The contract price is $1,158,000.

In a communication to the Montreal Builders' Exchange, the secretary of the Vancouver Exchange refers to the question of tenders for public works, more especially relating to those tenders for Dominion Government works. He states that it is the opinion of the Vancouver Exchange that these tenders should be opened in public at a time specified in the advertisement, and suggests that concerted action be taken with a view to the National Association of Builders Exchanges acting in the matter.

For the month of September the ordinary building permits of Montreal totalled $501,514, as compared with $1,999,524 in the corresponding period last year. By including the work of the current year of the Montreal Harbour Commissioners, such as docks, elevators and sidings—valued at $3,550,000—the total for last month is brought up to $4,051,514. The Commissioners are not bound to obtain a permit, but Mr. A. Chausse, the civic building superintendent, has always contended that the work should properly be included in Montreal's total, and he has done so in his return for September. For the nine months to date the total is $16,209,691, as against $15,816,146, but here again the harbour work is included. Without taking the latter into account the permits would show a decrease of $3,156,455. Last year the harbour work did not figure in the returns until November, when the amount was $3,000,000. The average value of the ordinary permits is lower this year than in 1913.

Personal Mention

Messrs. G. B. Reynolds, of the Trussed Concrete Steel Company; J. A. Stuart, of the A. B. See Electric Elevator Company; and G. M. Gest, have been admitted to the membership of the Montreal Board of Trade.

Mr. R. O. Wynne-Roberts, Consulting Engineer, has returned to Regina after a visit to Montreal, Toronto, New York, and other Eastern points. He was a recent visitor at the office of the Contract Record and Engineering Review.

At the meeting of the Canadian Society of Civil Engineers to be held on October 22, Mr. C. A. P. Turner will read a paper on "The Mechanical Action of Reinforced Concrete Floor Slabs and Columns as interpreted by the character of the deformations under load and the theory of work."

Over one hundred members of the Canadian Society of Civil Engineers volunteered for the front. These include past-presidents and ten past members of the council, together with many active and student members. Lieut.-Col. Ruttan, Lieut.-Col. Greenwood, and Major C. H. Mitchell are among those who offered their services.

Mr. H. A. Drury, principal of the firm of H. A. Drury, Limited, iron and steel merchants, Montreal, died in Atlanta, Ga., while on a business visit to the United States. Mr. Drury, who was a native of St. John, N.B., was 53 years of age. For a long period he was connected with the Imperial Oil Company and resigned about ten years ago to go into business on his own account. His firm represent important British and American companies, being general agents for Canada of the Lackawanna Steel Company, and also representing Sanderson Bros. and Newbold, of Sheffield, Eng. Mr. Drury was a member of the Canadian Mining Institute, and had sat on the council. He is survived by one son, Mr. A. K. Drury.

STANDARD TYPES

By Charles R. Barrett

The Man Who Quits

The man who quits has a brain and hand
As good as the next! but he lacks the sand
That would make him stick, with a courage stout,
To whatever he tackles, and fight it out.

He starts with a rush, and a solemn vow
That he'll soon be showing the others how;
Then something new strikes his roving eye,
And his task is left for the bye and bye.

It's up to each man what becomes of him:
He must find in himself the grit and vim
That bring success; he can get the skill,
If he brings to the task a steadfast will.

No man is beaten till he gives in;
Hard luck can't stand for a cheerful grin;
The man who fails needs a better excuse
Than the quitter's whining "What's the use?"

For the man who quits lets his chances slip,
Just because he's too lazy to keep his grip.
The man who sticks goes ahead with a shout,
While the man who quits joins the "down and out."

The Man Who Sticks

The man who sticks has this lesson learned:
Success doesn't come by chance—it's earned
By pounding away; for good hard knocks
Will make stepping stones of the stumbling blocks.

He knows in his heart that he cannot fail;
That no ill fortune can make him quail
While his will is strong and his courage high,
For he's always good for another try.

He doesn't expect by a single stride
To jump to the front; he is satisfied
To do ev'ry day his level best,
And let the future take care of the rest.

He doesn't believe he's held down by the boss—
It's work, and not favor, that "gets across."
So his motto is this: "What another man
Has been able to handle, I surely can."

For the man who sticks has the sense to see
He can make himself what he wants to be,
If he'll off with his coat and pitch right in—
Why, the man who sticks can't help but win!

Contracts Department

News of Special Interest to Contractors, Engineers, Manufacturers and Dealers in Building Supplies

Waterworks, Sewerage and Roadways

Barton Twp., Ont.

A conference re proposed water and sewer system for Barton Twp., has taken place between City Engineer Macallum, Hamilton, and Barton Twp. Engineer Nicholson. The scheme, as proposed, provides for $50,000 water system, sewer system that will empty into certain city sewers, and a sewer system to cost $10,000 for district east of James Street.

Bosanquet Twp., Ont.

The Township Council has in contemplation the construction of a number of drains. G. Sutherland, Thetford, Ont., is the clerk.

Brantford, Ont.

Surveys have been made for grading, estimated cost $7,000. The work will be done by City Construction Department. Mr. T. Harry Jones is City Engineer.

Canora, Sask.

Work is under way on a waterworks installation, estimated to cost $60,000 The engineers are Messrs, Chipman & Power, Winnipeg and Toronto, and the general contractors are Messrs. W. Newman & Company, Winnipeg. The work comprises pump house, water tower and laying of mains.

Cobalt, Ont.

Surveys have been made by Town Council's Engineers, Code & Code, preparatory to the construction of one mile of 15-in. sewers.

Cranbrook, B.C.

Waterworks system for this city will be completed some time next spring. Leader & Goode are the contractors.

Galt, Ont.

Ratepayers vote October 23 on by-law to raise $55,000 for extension of waterworks system.

Kingston, Ont.

Board of Works has recommended (a) grading of Patrick Street; (b) construction of sewer in College Street; (c) remacadamizing Union Street from Alfred Street to city limits, and (d) construction of a break water in King Street west at an estimated cost of $30,000.

Manitou, Man.

Tenders are to be called for construction of bridge across Pembina River between sections 4 and 5, township 2, range 7, as soon as plans have been prepared by Town Council.

Orillia, Ont.

The Town Council and Water, Light & Power Commission have succeeded in placing practically the whole issue of $85,000 waterworks debentures. The waterworks scheme will be proceeded with.

Ottawa, Ont.

The City Council has taken legal steps to test the validity of an order of Ontario Board of Health which directs that the city spend more than $8,000,000 on a water supply from Thirty-One Mile Lake, more than 50 miles from the capital.

The paving of Lisgar Street, between Elgin and Bank Streets, also Bronson Street, and with Rocmac between Laurier and Slater Streets, is contemplated by City Council. Mr. F. C. Askwith is Acting City Engineer.

Tile pipe sewers are to be laid from Lees Avenue to the Ottawa River. Mr. R. L. Haycock is Sewerage Engineer.

Regina, Sask.

City is proceeding with construction of a 5,000,000-gal. reservoir, provision for which was made in the Capital Estimates of city early this year. The excavation was carried out by day labor, and the work is under supervision of Superintendent of Waterworks.

Extensions to sewage disposal works are being made at a cost of $25,000. Plans and specifications are being prepared for supply of 9,000 sq. ft. of galvanized, corrugated iron for roofing and siding, also for steel work for roof construction of additional filter beds at sewage disposal works.

Richmond, B.C.

Announcement has been made that work will be completed this year on construction of 8 ft. dyke and 20 ft. ditch at an estimated cost of $26,000. Cleveland & Cameron, 470 Granville St., Vancouver, are consulting engineers. J. W. Pike, Vancouver, is general contractor.

St. John, N.B.

City Council will lay 7,000 ft. of watermains on fifteen streets by day labor, at an estimated cost of $18,000. The Water and Sewerage Commissioner is Mr. R. W. Wigmore.

Toronto, Ont.

The Board of Control has decided that the funds required for North Toronto waterworks should be taken from the $6,670,000 voted in 1913 for waterworks extensions. By this means the work will be carried out without submitting by-law.

By-laws to raise $1,340,000 for extension of watermains (including North Toronto supply mains, $525,000, and extensions to high-level pressure fire system, $500,000) are to be submitted to ratepayers. Mr. R. C. Harris is Works Commissioner.

Board of Control has received tenders for Don section, Bloor Street Viaduct, which have been referred to Commissioners for report. The amounts for reinforced concrete and steel respectively are as follows:—$1,125,000, reinforced concrete; $1,136,954.12, steel; $533,445, steel only; $1,109,760.75, steel; $1,353,074.91, steel; $996,564.81, steel; $1,098,781.82, reinforced concrete; $1,249,701, reinforced concrete; $849,005.35, reinforced concrete; $875,000, reinforced concrete.

The extension of Wilton Avenue from Bolton to Logan Avenues is recommended by Board of Control. Estimated cost $622,000.

West Vancouver, B.C.

This city is planning to install a new water system. A concrete dam 100 feet long and 26 feet high, capable of holding 1,100,000 gallons of water, will be constructed at a cost of $15,800. The system will include 18 miles of lap-weld steel pipe, 2,000 of which will be of 4 and 6 inch steel, and provision has been made for the erection of 65 hydrants for fire-protection purposes. The estimated cost of the system is $120,000.

The West Vancouver District is reported to have completed negotiations with the Cotton Company, Limited, Vancouver, for taking bonds in payment of work to be done in opening and improving Marine Drive from North Vancouver to Horseshoe Bay, a distance of about 8 or 10 miles.

CONTRACTS AWARDED

Hamilton, Ont.

McAllister & Company, Toronto, have been awarded the contract for the supply of cement sewer pipe at $16,000.

Niagara Falls, Ont.

Ferris & Manley of this city have the contract for sewer work estimated to cost $2,500. The engineer-in-charge is Mr. F. J. Anderson.

Richmond, B.C.

The contract for paving work between Lulc Island bridge and Sea Island bridge has been awarded by Town Council to N. P. Cotton & Company, at $2.30 per yard.

Toronto, Ont.

The Gawne Contracting Company of this city have obtained the contract for sewer construction on Argyle Street, estimated to cost $36,800. Smaller contracts have been awarded to Routly & Summers, J. McGuire, W. E. Taylor, Grant Contracting Company, and the National Contracting Company, all Toronto firms.

Contracts for sidewalk construction in various sections of the city have been awarded to the following firms:—International Contractors, Limited, Britnell Contracting Company, Ramsay Contracting Company, W. E. Ransom, Grant Contracting Company, H. Mitchell, Routly & Summers and R. J. Moyes & Company, all Toronto firms.

The Constructing & Paving Company and the Godson Contracting Company have been awarded contracts for asphalt

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Alphabetical Index of Advertisers
Page 18

Vol. 28 **October 28, 1914** **No. 43**

Principal Contents

Page
An Argument in Hard Facts 1311
Lord Kitchener's Business Sentiments 1312
"A Time of New Openings" 1312-13
Reinforced Concrete Design for Don Section of Bloor Street Viaduct, Toronto 1313
The Shape of Theatre Interiors 1313
Methods Employed on Pneumatic Foundation Work at Montreal 1314-16
Checking Lists for Estimators on Building Work .. 1317-19
By L. A. Waterbury
Limitations of Water Filters 1318
By George W. Fuller
The Relation of Geology to Railway-Tunnel Location 1320-22
By Edwin C. Eckel
A Discussion of Traffic Factors 1322-24
By J. Eastwood
Tile Work Decoration 1324-5
New Civic Library for Montreal 1325
New Police Headquarters at Vancouver 1326-7
Sewage-Disposal Works in European Cities 1328
By George E. Datesman
The Durability of Creosoted Piling 1329
Fire Prevention 1330-31
Patents and the War 1332
By Stanley Lightfoot
Personal Mention 1332
Constructional News 1334-5

An Argument in Hard Facts

CANADA is beginning to pick up some of the trade which may be said to have been occasioned directly by the war. Hon. Robert Rogers is responsible for the statement that not only Great Britain, but France and Russia, are placing, or preparing to place, orders which involve the expenditure of millions of dollars. Already contracts have been received from France and Russia for 35,000 saddles, while Great Britain has ordered 10,000 and Canada an additional 10,000. In addition, orders have been placed for some 6,000 sets of harness. Assurance has been received from the British Government that large orders for supplies will be placed in Canada, and already contracts for blankets and shirts to the value of $7,000,000 have been placed. "Canadian-made goods will get such a showing in the markets of France and Russia," says Hon. Robert Rogers, "that Canada should easily become the first nation in exporting to those countries."

In regard to the commercial future of Canada, Mr. Rogers is most optimistic. "With immense orders coming in from the allies," he states, "the industrial output of the Dominion will be well maintained and the coming year should be an exceptionally busy one for Canadian manufacturers."

It is certain that the onus of such statements would not be accepted by such an authority as Hon. Robert Rogers unless material evidence were at hand. The reflection is one which should provide much encouragement for the constructional interests. If the foreign business materializes, a great impetus will be provided Canadian enterprise and in many cases immediate and rapid expansion of manufacturing facilities will take place.

In many respects Canada stands unique as a country able to develop the sinews of war for Great Britain and her allies, and it is to be hoped that our manufacturers will rise to the occasion and prosecute their opportunity with enterprise and vigor. Upon the manner in which they do rise to the occasion depends solely the extent of the trade which will remain to them after the termination of hostilities.

This opportunity of over-seas business is a final argument in favor of a policy of "meeting the present with an eye to the future." This can be effected not by wholesale reductions in staffs and the curtailment of legitimate business expenditure, but by putting forth every effort to maintain the stability of normal times in preparation for the activity which the Hon. Robert Rogers foresees.

In face of Canada's prospects, to relinquish one's hold upon business because of a temporary depression is nothing but business suicide. This is a period of testing, and there is every reason to believe that Canada will emerge from it with the proved capacities of stability and business foresight. With all the horrors of war it is not unlikely that the present conflict will prove to be that tide in Canada's affairs "which, taken at the flood, leads on to fortune."

An order has been received from the British War Office for 200,000 shells. The contract will be divided among various Canadian firms and will keep 1,500 Canadian steel-workers busy. The present contract will not be completed for eight months. The inspection to which the shells are subjected in England is very strict. It is necessary that the finished product pass tests conducted by the officials of the War Office.

The steel shell is made in Canada and filled with leaden bullets. It is loaded with powder at the arsenals in England after the shells have been received and tested. It is stated that this contract and other orders in prospect will open up a new industry in Canada.

Lord Kitchener's Business Sentiments

NOT long since we advanced the editorial plea of "Business as Usual" and observed that "the principles for which it stands are playing a part in the affairs of the Empire second only in importance to the operations in the actual theatre of conflict." There are many who would characterize such sentiment as the natural outcome of a business disposition, but we are assured of the moral support of no less an authority than the head of the British War Office, Lord Kitchener, who writes to Messrs. Siemens Brothers & Company, Limited, expressing his appreciation of the efforts made by the firm's employees and of the quality of the work turned out, at the same time emphasizing his desire that everything shall be done to assist the military authorities by pushing on all orders as rapidly as possible. Lord Kitchener concludes:—

> "I should like all engaged by your company to know that it is fully recognized that **in carrying out the great work of supplying munitions of war they are doing their duty for their King and Country equally with those who have joined the Army for active service in the field."**

The phrase "munitions of war" is capable of wide interpretation and it may be said to apply to practically every phase of activity which may be classified as constructional. The business of supplying a nation with food, wearing apparel, places to live in—and work, must proceed vigorously whether a country be at war or not. A country devastated by poverty, short rations, ill-housing and lack of employment would soon be unable to develop the sinews of warfare. This principle is recognized in the old country and it is reflected in the statements of a man of such unflinching devotion to the interests of the army as Lord Kitchener.

"The Time of New Openings," says an English Writer in the Westminster Gazette

NOTHING is so difficult as living up to a sentiment, especially when the sentiment has been made for you by somebody else. There are displayed in thousands of shops in London and in hundreds of factories nicely printed notices, "Business as usual," and, with some dazzling exceptions, the proprietors of those notices wonder with lugubrious countenances why business is not as usual. Business is not going to be as usual if in a time of stress and strain men believe that the machinery can be kept running with no more exertion than when the load to be carried is light. No owner of a motor car expects that he can take a hill with the petrol throttled down. He opens his valves, and the engine responds to the fresh impulse. The same thing is true of business life. If speed is to be kept to the normal there must be more energy, more explosive force, more of the will to put one's back into things when the steep and rough road has to be climbed.

"Business as usual" was a good enough motto for the early days of the war, but it is a wretched enough sentiment for a people of enterprise when new opportunities are opening out in every direction. The call at such a time is not for the man who thanks Heaven that his affairs are not so bad as they might be, but for him who says "This is the occasion for which I have longed. I will go out and conquer."

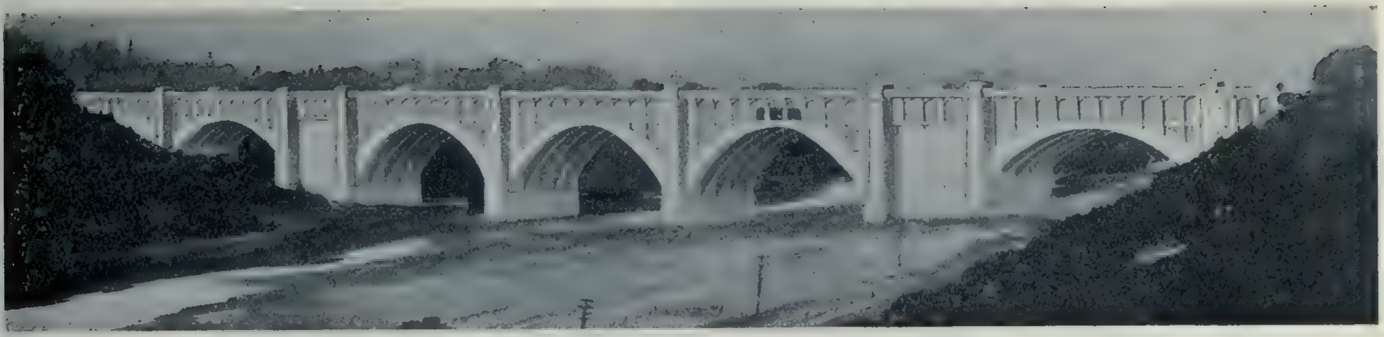
Ever since Germany began to feel its strength in the industrial world the feebler folk have prayed for something to deliver them from this new competitor. "Make him mark his goods," said one school, "and then people will not buy from him." And when the goods were marked people still bought. "Only give us a tariff and then we shall be safe," chimed in another school. In a day, by one single stroke, more has been achieved than the highest tariff wall could have made possible. The formidable competitor has gone; his goods can no longer find their way into the markets of the world; marked or unmarked, charged with a tariff or admitted free, they have ceased to be. And not only in the British market, but in the markets of the world. Wherever a German-made article was supplied, there is room for a British-made article, and if the Britisher does not fill the gap somebody else will. The manufacturer, the wholesaler, or the dealer who anchors himself to the motto "Business as usual" in that situation is not a business man but a vegetable.

Germany's Great Export Trade

Last year Germany sent to this country over forty millions in value of goods, a large proportion of which were partially or wholly manufactured. All these goods have to be replaced somehow; they are wanted by our population of forty millions. There are scarcely any of these articles which cannot be made here, given the capital and the enterprise. They can be made better than they were made by the Germans. But it won't be sufficient to make the goods. They must be marketed, which means that people must know the things they want are being made and where they can be obtained. There is new business to be done, but the customers who are waiting have to be told what people are anxious to have new business and are not content with the purely negative attitude of going on as usual.

Let the plain man take it as a plain fact that "Business as usual" is not going to provide him with a fortune or even enable him to finish the year with his usual substantial balance. He is going to have heavier expenses, higher taxation, greater initial costs. His goods, in an outworn phrase, are going to cost him more, and if he has been buying from the Continent he is not going to get the goods at all. He has to seek new sources of supply and stimulate home manufacturers to strike out along new lines or increase their output to meet new demands. That forty millions of trade in the home market is worth picking up, and somebody will be compelled to pick it up, but it won't be done with the motto "Business as usual," but with the finer idea that new opportunities call for new methods. And when the forty millions have been absorbed the world is a veritable Tom Tiddler's ground in which the gold will be seized by those who have the sight to see that the gold is there.

Let there be no mistake! The buyer is not coming to the man who has over his door the sign "Business as Usual." The seeker after goods is looking for the announcement, "I Want to do New Business." He is seeking, that is to say, the manufacturer or dealer who recognizes possibilities and lets the world know he is ready to fill the new demands arising on all sides. He



Reinforced Concrete Design for Don Section of Bloor Street Viaduct, Toronto

THE above illustration is a perspective of the design prepared by Messrs. James, Loudon & Hertzberg, Engineers, Toronto, for a reinforced concrete bridge on the Don Section of the Bloor Street Viaduct, Toronto. The scheme, which consists of two sections, the Rosedale and the Don, is estimated to involve an expenditure of approximately $2,500,000. The project has been before the ratepayers of Toronto for the last three years, it having been submitted in the form of a by-law in 1911, when the proposal was defeated, and again the following year with a similar result. Finally it met with public approval on the third occasion, in January 1914. The Don Valley section extends from Castle Frank Road to Danforth, its length being about 1,500 feet and its width over all, 86 ft. The longest arch spans are 200 ft. The Board of Control invited tenders on steel and reinforced concrete construction, the design for the former appearing in the Contract Record of July 15, 1914. The lowest tender received on the reinforced concrete type was based on the design of Messrs. James, Loudon & Hertzberg, the amount of the tender of Messrs. Jones & Girouard, Ottawa, being $849,055. The lowest of the steel tenders was submitted by Messrs. Quinlan & Robertson, at $996,565. The design providing for steel construction was prepared by the Commissioner of Works, Mr. R. C. Harris. For some time there has ben a lively controversy as to the merits of the respective types of construction, and the result of the examination of the designs by a special committee is awaited with keen interest.

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wants to know where his wants can be supplied. He is after the man who advertises. Nothing has been more foolish in the upheaval of settled courses than the widespread decision to cease advertising, and to be content, as a consequence, with dwindling trade. The purpose of advertising is to create customers who will inquire for goods. Without the customers, manufacture and the whole machinery of business is just so much wasted material and effort. With the customer in waiting, there follows the orderly movement of industry and commerce, with profits for all concerned. In exciting days those who want goods want to know also where they can be obtained without the time-testing difficulty of long inquiry and searching. The ready means to inform them is by advertising. No other means can bring about the same results at anything like the same cost.

In orderly days some businesses can subsist without advertising. They go on their settled way doing a regular trade with a fixed number of people on their books. But these are times when new business must be done, when fresh customers must be sought, when the easy-chair attitude is no longer possible. Never was there a period in which wants were changing so rapidly, when there was so insistent a call for daring and enterprise. When the wreck of this war comes to be cleared up, the businesses which will emerge stronger than ever they were will be those which have had faith in themselves, which have not feared in the crisis, but have seized with avidity the chances of the hour and have let the world know that they were doing so.

Concerning the Shape of Modern Theatre Interiors

IN commenting upon the shape of theatres or rather of their auditoria, a writer in a recent issue of the London Times calls attention to the fact that when James Burbage built the first public playhouse he made it round, thus following the principle adopted in the Greek and Roman theatre, the Roman amphitheatre, the bull-rings and bear-rings. The writer makes the point that the Elizabethan theatre had its stage out in the arena, with the audience on three sides of it, and the "Restoration" stage had its "apron" projecting so far out into the auditorium that the people in the side boxes must have seen a great deal of the action from behind.

The modern theatre, it is pointed out, has entirely altered the relative position of stage and audience. The stage is no longer among the audience, but a framed picture in front of them, and the writer therefore suggests that the proper shape for a modern theatre auditorium is rectangular, and the retention of side galleries a solecism. Theoretically the principle of the writer is sound, but he forgets that galleries on the side walls enable a larger audience to be grouped within a theatre of a given size, thus with any given audience bringing a larger proportion nearer to the stage, and as theatres are commercial ventures—often, we might say, speculations—making for economy in cost of erection. It may be remembered that in many large concert halls of rectangular form side galleries are used as well as those at the end.

Montreal Examining Warehouse Architect's perspective of finished building.

Methods Employed on Pneumatic Foundation Work at Montreal

The Foundation Company's Contract in Connection with the Montreal Examining Warehouse and Customs House

PNEUMATIC foundations involving 132 caissons from ground level to rock at 68 or 70 ft. below the ground level are of sufficient importance to merit passing notice. A contract of this size has been completed recently in Montreal, P.Q., for the Dominion Government.

The increasing importance of Montreal as a port of entry influenced the Dominion Government to increase the efficiency for handling the business passing through the Customs Examining Warehouse, and plans were drawn up for a building on the Government property on McGill Street between Place Youville and Youville Street.

The contract as let covered about one-half of the proposed building. At this time pneumatic foundations were not specified. The cellar over the south one-half of the lot was excavated to a general level of about 15 ft. below the surrounding street level, and from the cellar level the sub-contract was later let, covering the pneumatic foundations. This first half was commonly known as the First Part, and about four months later another contract was sublet covering the north half of the lot, which was called the Second Part or the extension. As the work was continuous it is not distorting facts to call the two parts one piece of work involving 132 caissons, 69 on the first part and 63 on the second part.

Diamond drill borings were made to develop the sub-soil conditions before the final type of foundation piers were decided upon, such borings being considered absolutely necessary for the intelligent study of the foundation problem, as it enabled the contractors to adapt at the start methods best suited to the existing conditions.

The average curb level on McGill Street was about El. + 28 referred to mean water level in the harbor as zero. At about El. + 5 water was encountered in sufficient quantity to necessitate the use of air in excavating for the foundations. The proposed building was of monumental design and the loads were consequently high. The allowance made for loading on the rock was 16 tons per square foot, this factor determining the size of the larger caissons. On the interior piers, where the loads were lighter, the minimum size caissons was used, the areas of same being determined by the smallest size which could be constructed practically by the pneumatic method.

Caisson lock with auxiliary derrick.

Typical built-up caisson with lock set.

Three types of caissons were sunk; the first type comprised caissons with timber working chambers, the second type had concrete working chambers, and the third was adopted to utilize nine dredging caissons, previously started, that were to be converted into pneumatic caissons.

The general procedure in the case of the wooden caissons differed from that of the concrete caissons only in that the concrete working chambers were built in place whereas the wooden working chambers were built in the yard and swung into place by derricks. It is customary to excavate at the site of the pier for a depth of about 5 or 6 ft., and in this pit the working chamber forms were set, shafting and piping attached, and concrete poured in until the caisson was built up as high as the derricks could reach. The concrete was then allowed to stand and the operation of sinking was started by excavating within the working chamber and taking the material out through the shafting by means of caisson buckets hoisted by derricks. When the cutting edge reached about El. + 5, where water necessitated either the putting on of air or more extensive pumping, the sinking was stopped and the caisson again built up to its final height. Compressed air locks were then placed on the shaft, air turned on, and the excavation in the working chamber again started and continued until the caisson had settled to within about ten feet from rock, which brought the top of the built-up concrete to the finished level. The remaining distance to rock was sunk without sheathing or bracing of any kind except the air pressure. When bottom was reached all loose material was removed until good bed rock was secured, then the concreting operations started, which consisted of pouring concrete into the working chamber until it was full, and then filling up the shaft. It will be seen that, by this method, a solid concrete column was obtained from rock to the top of the pier without intervening layers of timber.

Prior to the decision to use the pneumatic method nine caissons had been constructed and dredged to approximately El. — 3 and the operation covering the sinking of these caissons differed from that described above in that it was necessary to convert them into pneumatic caissons and to straighten them, as they were considerably out of plumb. The operation of handling these caissons was first to pump them out, build in a deck, place the shafting, pour a concrete plug, and then concrete around the shafting. After the concrete had stood, more concrete was placed above the working chamber and sinking operations started.

Caissons built up ready for sinking.

The derrick lay-out was planned to give the minimum number of set-ups. The derricks were cribbed up to approximately ground level, which enabled them to place the air locks on the caissons when they were built to their full height on the second lift. The yard for building the caissons was located on McGill Street, as it interfered less at this point with other operations.

Temporary plant was located as closely as possible to the centre of the lot as a whole. Should the Government go ahead with the second part of the building, all available space on the lot was needed for other operations. The concrete mixer had to be placed so as to serve all the derricks, and a point at the centre of the lot was considered the most economical and efficient. The mixer on the first half was located on the cellar level and the material was brought in on the street level. On the second half the mixer was about 6 ft. from the average street level, and the material was delivered to the mixer by an automatic dumping bucket which was loaded at the ground level.

The boiler plant consisted of two 350 h.p. vertical boilers and two 100 h.p. locomotive type boilers. These supplied steam for the compressors, concrete mixer, several hoist engines, as well as a number of steam injectors for unwatering the caissons that were not under compressed air.

The compressor plant consisted of three low pressure machines, the combined capacity of which was about 4,000 cubic feet per minute, and one high compressor machine for the operation of rock drills and boring machines, etc. A 40 kw. dynamo supplied direct current for lighting purposes. A hospital lock was installed for the treatment of any caisson disease that might occur on the job.

The piping system consisted of a 6-in. air main with 4-in. branches running off to serve the caissons, and from these branches, the air was connected direct by two independent lines to the working chambers as well as the usual piping to the locks.

The hoist engines used were of the double drum type, cylinders 7-in. x 10-in. with swing engines having 6 x 8 cylinders. Seven-ton capacity derricks were employed, the fittings for which were specially designed by the contractors. Auxiliary derricks were attached to the air locks, and were operated by 6-in. x 8-in. single drum hoist engines. The mixer was of 30 cubic feet capacity with boiler and engine attached. Lot pumping when necessary was handled by Cameron pumps.

The contract for the pneumatic work on the first section was begun in May, 1913, and the 69 caissons involved were sunk to rock and completed by November, 1913. The contract for the second section was begun in November, 1913, and the 63 caissons on this part were sunk to rock and finished by March, 1914. Some of the quantities involved were approximately 22,250 yards of caisson excavation, 16,000 cu. yds. of concrete, 1,500,000 F.B.M. timber, 24,000 lbs. cement, 1100 boiler h.p., 13 hoisting engines, and 11 air locks.

The work was done under the direction of the Chief Architect's office of the Department of Public Works. Mr. LaPierre represented the Department for the first part and Mr. LaCroix for the second part. The Foundation Company, Limited, were the contractors on all the pneumatic work. Messrs. P. Lyall & Sons Construction Company, Limited, were the general contractors.

The floor panels of the Ford Motor Company's assembling plant at Portland, Ore., are said to be about the largest ever used in a floor of the mushroom type. Plans for the building were filed with the building inspector's office about a month ago and show a 3-storey building, 75 x 300 ft., of reinforced concrete built on the Acme flat-slab system. The slabs are to be 27 by 28 in., 11 in. thick, with some special slabs 20 and 22 ins. thick.

Checking Lists for Estimators on Building Work*

By L. A. Waterbury†

THE preparation of detailed estimates and bills of material for the use of contractors requires considerable care to avoid the omission of items. For work of this character the writer has made use of checking lists which should prove of interest to others. Mimeographed forms are used, made upon 16-lb. bond paper, 8½ x 11 ins., so that the preparation of checking lists for a particular job is done by checking the required items which are listed upon the forms and by adding any unusual items which do not happen to be included upon the mimeographed list.

Before beginning to itemize the quantities to be billed the checking lists are made out for the entire job. For a new job much of this can be done while studying the plans and specifications, noting in particular those items called for in the specifications which might easily be overlooked in taking off quantities from the plans.

The form shown in Fig. 1 is for use in checking the general subdivision of items for building estimates. It will be noted that this form is arranged to indicate whether any particular item is to be furnished by the general contractor or whether it forms a sub-contract. The list also shows whether materials or labor, or both, are required. In the column headed "Required," under each subdivision, a check mark is placed opposite each item for which there is anything to be billed. In the column headed "Check List" there is placed the number of the sheet on which will be found a detailed check list for the item. For some items no detailed check list will be needed. In the column headed "Itemized" there is placed the number of the sheet on which the billing of the item begins. When the billing for an item of the general list has been completed, a second check mark is placed in the "Required" column, for which purpose it is desirable to use a different color than that used for the first check. The writer uses black for the first checking and red for the final checking.

In billing the items, all of the materials may be itemized first, then the labor, and to the summary of these may be added the sub-contracts. In this case the final checking proceeds down each vertical column in succession. When it is desired to bill the items so as to show the complete cost of materials and labor for the separate items, the checking proceeds across the horizontal lines in succession. Upon completion of the estimate the checking list serves as an index for reference to the itemized bill.

A detailed checking list for concrete is shown in Fig. 2. Similar detailed checking lists for lumber and millwork are shown in Figs. 3 to 7 inclusive. It will be noted that the detailed lists differ from the general

Job.. Sheet..........
Checking List for GENERAL CLASSIFICATION FOR BUILDING ....
Listed by.......... Date.......... Checked by.......... Date..........

ITEM NO.	ITEMS FURNISHED BY GENERAL CONTRACTOR						SUB-CONTRACTS			DESCRIPTION OF ITEM
	MATERIALS			LABOR						
	Required	Check List	Itemized	Required	Check List	Itemized	Required	Check List	Itemized	
1										PREPARATION AND PRELIMINARY
2										ALTERATIONS
3										CLEARING
4										EXCAVATION AND FILLING
5										CONCRETE AND CEMENT WORK
6										REINFORCING STEEL
7										STONEWORK
8										BRICKWORK
9										TERRA-COTTA
10										TILE-WORK
11										WATERPROOFING
12										CARPENTRY
13										Dimension Lumber
14										Unworked and Rough Uppers
15										Worked Uppers for Exterior Trim
16										Worked Uppers for Interior Trim
17										Millwork and Glass
18										Roofing (If done by carpenter)
19										
20										ROOFING (If separate item)
21										PLASTERING AND LATHING
22										SHEET-METAL
23										STEEL AND IRONWORK (Except reinforcing)
24										HEATING
25										PLUMBING
26										GAS FITTING
27										VACUUM CLEANING SYSTEM
28										ELEVATORS
29										ELECTRICAL WORK
30										ROUGH HARDWARE
31										FINISHED HARDWARE
32										PAINTING
33										CLEANING UP
34										
35										
36										

Fig. 1.—Checking list for general classification of work.

Job.. Sheet..........
Checking List for CONCRETE FOR ....
Listed by.......... Date.......... Checked by.......... Date..........

ITEM NO.	ITEMS FURNISHED BY GENERAL CONTRACTOR						SUB-CONTRACTS			DESCRIPTION OF ITEM
	MATERIALS			LABOR						
	Required	Places	Itemized	Required	Places	Itemized	Required	Places	Itemized	
1										FOOTINGS
2										FOUNDATION WALLS
3										FOUNDATION PIERS
4										COLUMNS
5										WALLS EXCLUSIVE OF FOUNDAT'N
6										FLOORS
7										CEILINGS EXCLUSIVE OF FLOORS
8										ROOF
9										COPING AND CAPS
10										WATER TABLES and BELT COURSES
11										ENTABLATURES AND CORNICE
12										LINTELS
13										SILLS
14										CHIMNEYS AND VENT STACKS
15										EXTERIOR STEPS
16										INTERIOR STAIRS
17										HEARTHS
18										SWIMMING POOLS
19										TANKS AND RESERVOIRS
20										SIDEWALK
21										CURBING AND GUTTERS
22										MANHOLES
23										COVERS (Manholes, Cess Pools, etc.)
24										CONCRETE PIPE
25										CAISSONS, WELL CURBS, ETC
26										
27										
28										
29										
30										
31										
32										
33										
34										
35										
36										

Fig. 2.—Checking list for concrete work.

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*Engineering and Contracting, Chicago.

†Professor of Civil Engineering in the University of Arizona.

list in that "Places" is used as a column heading in the detailed lists where "Check List" is used in the general list. In the column headed "Places" there is inserted the number of places on the job where the corresponding item occurs. Certain items occur on more than one list, since for different cases they will need to be billed in different ways, depending usually upon whether the materials required can be purchased from stock or whether they are special. In case all of the interior trim is obtained from the mill the lists for interior trim and for millwork virtually form a single list. If some item, such as "Ceiling," is not included in the items to be obtained from the mill, whereas the balance of the items on the list come from the mill, no confusion would ordinarily occur, since the items to come from the mill would be checked in the column headed "Sub-contracts," and the item "Ceiling" would be checked under "Items Furnished by General Contractor."

Job.. Sheet....................
Checking List for DIMENSION LUMBER FOR ....
Listed by........................ Date.............. Checked by.................. Date..................

ITEM NO.	ITEMS FURNISHED BY GENERAL CONTRACTOR						SUB-CONTRACTS			DESCRIPTION OF ITEM
	MATERIALS			LABOR						
	Required	Places	Itemized	Required	Places	Itemized	Required	Places	Itemized	
1										MUD SILLS
2										UNDERPINNING
3										SILLS
4										GIRDERS
5										FLOOR JOISTS
6										CEILING JOISTS
7										BRIDGING (Over 1 in.)
8										STUDDING
9										BRACING FOR STUDDING
10										RIBBON GIRTS (Over 1 in.)
11										PLATES
12										POSTS AND COLUMNS (Unmilled)
13										PILLAR FRAMING
14										BOLSTERS AND CORBELS
15										ROOF TRUSSES
16										PURLINS
17										RAFTERS
18										COLLAR BEAMS (Over 1 in.)
19										RIDGE BOARDS (Over 1 in.)
20										ROOF BRACING (Over 1 in.)
21										STAIR STRINGERS
22										PARAPET FRAMING
23										RAILINGS (Unmilled)
24										TOWER FRAMING
25										CORNICE FRAMING
26										SKYLIGHT FRAMING
27										WOOD LINTELS
28										ROUGH DOOR BUCKS
29										CONCRETE FORMS (Over 1 in.)
30										STAGGING
31										
32										
33										
34										
35										
36										

Fig. 3.—Checking list for dimension lumber.

For reinforcement, a list having the same items as the list for concrete is suitable. For other items of the general classification, such as brickwork, stonework, etc., detailed checking lists are not difficult to prepare. The lists for lumber are given in detail because the writer has had considerable difficulty in developing lists which were satisfactory.

The following comparative statistics are illuminating as to the progress by the province of Saskatchewan during the last decade. The population has increased from 140,500 to 675,000 and the railway mileage from 1,053 to 5,356. In 1903 the total area surveyed was 64,152 square miles and in 1913, 121,680 square miles. In the former year there were 240 grain elevators with a capacity of 7,205,000 bushels and in the latter year there were 1,424 grain elevators with a capacity of 44,294,900 bushels. Ten years ago the cities, towns, villages and municipalities combined totalled only 20, while at the end of 1913 there were 7 cities, 71 towns, 281 villages and 295 municipalities.

Limitations of Water Filters*

By George W. Fuller, Consulting Engineer, New York

It has often been taken as a matter of course that the addition of an ordinary water filter either of the slow sand type or the mechanical type would be sufficient to bring the water to a condition of perfect purity in all its properties and make it absolutely satisfactory and sufficient for all drinking purposes. There seems no doubt that a water filter can only affect so much and no more in the way of bacterial purification. Having in mind limits such as these, it will be necessary to determine how much of a burden the condition of the raw water will impose on the filter.

B. Coli Determination

A water may have a very large number of bacteria and still be absolutely harmless. The determination of B. coli has come to be recognized to be the most satisfactory of the possible methods of determining the pollution of a water. B. coli of itself is not, of course, any direct indicator of disease-bearing bacillus. It is only a very indirect evidence of the possibility of recent fecal pollution.

An International Joint Commission, composed of appointees of the United States and of Canada, has been investigating the pollution of the international boundary waters, with the idea of determining to what extent pollution must be limited in order not to endanger the health of the communities on the two sides of these boundary waters. The best that can be done with the data at hand is to consider all these data, properly weigh them, and on the basis of a rather general judgment come to some conclusion on what is a proper limit of B. coli in water to be applied to the filters. Such a conclusion can by no means be considered rather an average than a rigid limit for any particular case. This standard specifies that water applied to filters should show by the presumptive test not more than 500 B. coli per 100 cu. cm. of water as a yearly average, meaning by this that B. coli should not be found more than 50 per cent. of the time in 0.10-cu. cm. samples. For averages for shorter selected times, monthly, weekly, or daily, the allowable B. coli content may be considerably higher. It is believed that for this purpose the averages based on a year's readings are more useful than averages for a shorter time with a correspondingly different standard of allowable B. coli.

The bacterial efficiency of a filter is not an invariable quantity. Roughly speaking, 98 to 99 per cent. may be placed as a fair average under ordinary conditions. With these conditions in mind, it seems reasonably safe to say that a water having in its raw form a coli content not exceeding 500 per each 100 cu. cm., based on yearly averages, will show in the water supplied to the consumers something not more than five to ten B. coli per 100 cu. cm. Such water is believed to be a fairly safe water, when properly sterilized, for drinking purposes and for all other domestic uses.

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*From a paper abstracted by the Engineering Record.

Job .... Sheet ....
Checking List for UNWORKED AND ROUGH UPPERS FOR ....
Listed by .... Date .... Checked by .... Date ....

ITEM NO.	ITEMS FURNISHED BY GENERAL CONTRACTOR						SUB-CONTRACTS			DESCRIPTION OF ITEM
	MATERIALS			LABOR						
	Required	Places	Itemized	Required	Places	Itemized	Required	Places	Itemized	
1										RIBBON GIRTS (1 in. and under)
2										PLATES "
3										BRIDGING
4										BRACING FOR STUDDING "
5										ROOF BRACING " "
6										COLLAR BEAMS "
7										ROUGH FLOORING
8										SHEATHING
9										UNW'RK'D LUMBER, PILLARS (1 in.)
10										" " STAIRS "
11										" " PARAPETS "
12										" " RAILINGS "
13										" " LOUVRES "
14										" " TOWERS "
15										" " SKYLIGH'S "
16										" " EXTER. TRIM
17										" " INTER. TRIM
18										FURRING STRIPS
19										GROUNDS
20										RIDGE BOARDS (1 in.)
21										LUMBER FOR FORMS (1 in.)
22										LUMBER FOR STAGGING (1 in.)
23										
24										
25										
26										
27										
28										
29										
30										
31										
32										
33										
34										
35										
36										

Fig. 4.—Checking list for unworked and rough uppers.

Job .... Sheet ....
Checking List for WORKED UPPERS FOR EXTERIOR TRIM FOR ....
Listed by .... Date .... Checked by .... Date ....

ITEM NO.	ITEMS FURNISHED BY GENERAL CONTRACTOR						SUB-CONTRACTS			DESCRIPTION OF ITEM
	MATERIALS.			LABOR						
	Required	Places	Itemized	Required	Places	Itemized	Required	Places	Itemized	
1										LOUVRES
2										RAFTER ENDS
3										FINISHED SHEATHING
4										SIDING
5										RAILINGS (If not in Millwork)
6										CORNICE
7										FRIEZE
8										ARCHITRAVE
9										TENIA
10										SOFFITS
11										LUMBER FOR COLUMNS & PILLARS
12										FINISHED FLOORING (Exterior)
13										STAIRS AND STEPS "
14										BELT BANDS
15										WATER TABLE (If not in Millwork)
16										DRIP CAP
17										CORNER TRIM
18										GRILLE AND PATTERN TRIM
19										LATTICE WORK
20										PARAPETS
21										CEILING (Exterior)
22										SHINGLES
23										BATTENS
24										PICKETS
25										BENCHES (Ifnot in Millwork)
26										
27										
28										
29										
30										
31										
32										
33										
34										
35										
36										

Fig. 5.—Checking list for worked uppers for exterior trim.

Job .... Sheet ....
Checking List for WORKED UPPERS FOR INTERIOR TRIM FOR ....
Listed by .... Date .... Checked by .... Date ....

ITEM NO.	ITEMS FURNISHED BY GENERAL CONTRACTOR						SUB-CONTRACTS			DESCRIPTION OF ITEM
	MATERIALS			LABOR						
	Required	Places	Itemized	Required	Places	Itemized	Required	Places	Itemized	
1										FINISHED FLOORING
2										CASING (Windows, Doors)
3										PULLEY STYLE (If not with frames)
4										DOOR JAMBS " "
5										STOPS (Windows, Doors)
6										WINDOW STOOL
7										WINDOW APRON
8										BASE MOULD (Pieces)
9										PICTURE MOULD (If stock pattern)
10										PLATE RAIL " "
11										FALSE BEAMS " "
12										CHAIR RAIL
13										WAINSCOT
14										SHELVING
15										HOOK STRIPS
16										CEILING
17										THRESHOLDS
18										STAIRS (If not in Millwork)
19										DRAIN-BOARD " "
20										BENCHES " "
21										COUNTERS " "
22										INTERIOR COLUMNS(Except Millw'k)
23										LATH (If not included in plaster)
24										
25										
26										
27										
28										
29										
30										
31										
32										
33										
34										
35										
36										

Fig. 6.—Checking list for worked uppers for interior trim.

Job .... Sheet ....
Checking List for MILLWORK AND GLASS FOR ....
Listed by .... Date .... Checked by .... Date ....

ITEM NO.	ITEMS FURNISHED BY GENERAL CONTRACTOR						SUB-CONTRACTS			DESCRIPTION OF ITEM
	MATERIALS			LABOR						
	Required	Places	Itemized	Required	Places	Itemized	Required	Places	Itemized	
1										WINDOW FRAMES, DOUBLE HUNG
2										" " CASEMENTS
3										" " FIXED SASH
4										DOOR FRAMES, DBL. WITH TR.
5										" " " NO "
6										" " SIN. WITH "
7										" " " NO "
8										VENT FRAMES (If milled)
9										SCUTTLE FRAMES " "
10										LOUVRES " "
11										STORE FRONTS
12										SASH, DOUBLE HUNG
13										" CASEMENTS
14										" FIXED
15										SKYLIGHTS
16										GLASS (If not with other items)
17										DOORS, EXTERIOR
18										" INTERIOR
19										" SCUTTLE OR BATTEN
20										STAIRS (If milled)
21										RAILINGS "
22										PLATE RAIL "
23										DRAIN BOARD (See Interior Trim)
24										BENCHES " " "
25										COUNTERS " " "
26										COLUMNS (If milled)
27										CORNICE " "
28										FRIEZE & ARCHITRAVE (If milled)
29										SOFFITS (If milled)
30										CABINETS AND CASES
31										
32										
33										
34										
35										
36										

Fig. 7.—Checking list for millwork and glass.

Checking Lists for Estimators on Building Work.

The Relation of Geology to Railway-Tunnel Location[*]

By Edwin C. Eckel[†]

Most railway tunnels are so located as to pass through a barrier range at some relatively low point. The railroad was headed for a gap or pass through the range in order to secure as low a crossing point as possible, and the tunnel represents an effort to make a little further reduction in the elevation of the crossing point.

The fact that a gap or pass exists at a certain point in a mountain range is not a matter of accident; there is always a cause for its location at that particular point. In most cases, it is possible to say, after study of the case in the field, that the pass owes its location to some peculiarity in the structure or composition of the rocks at that point.

Other things being equal, depressions along a mountain ridge are likely to occur where soft or soluble rocks reach the ground surface. If the rocks of the range are so placed that a depression of this kind extends at right angles to the range, it may in time be extended entirely across it, giving rise to a gap. Fig. 1 illustrates a hypothetical case of this kind, where a series of limestones, inclosed by harder rocks, have been worn down below the general crest level. On a small scale, gaps owing their origin to this cause are fairly common.

A second cause is erosion of the crest of an arch or anticline. Fracturing is common at this point during the folding of the rocks, and the weakness thus induced may at a later date give rise to deep erosion along the weakened zone, and the ultimate formation of a gap across a ridge. This is illustrated in Fig. 2, showing a condition which could be readily duplicated in many parts of the South.

Faulting on a large scale also causes zones of weakness and easy erosion, and gaps may arise from this cause, as shown in Fig. 3. In many cases, where a gap or pass is located along a fault zone, we have to deal not only with such weakness as may have been the direct result of faulting, but with the fact that the fault may have brought into contact at the surface two sets of rocks differing widely in hardness and resistance to weathering. In such cases, the gap is due to the indirect effects of the fault, rather than to the direct structural weakness.

Another very common type of gap, particularly in certain portions of the southern Appalachian region, is that caused by the arrangement of the rock folds and, consequently, of the mountain masses. This can be seen best along the line of the Chesapeake & Ohio R. R. in the section near the Virginia-West Virginia state boundary, where examples are encountered at frequent intervals. The rocks in this area are arranged in steep folds, and in most cases the mountain ridges represent actual arches or anticlines in the underlying rocks. Cross folding at intervals causes an echelon arrangement of the ridges, and the roads and streams follow through around the ends of these ridges at relatively low crossings. Fig. 4 is an attempt to suggest the main features of this sort of topography.

If the entire ridge which has to be tunneled were composed of one kind of rock, if the structure of this rock were everywhere uniform, and if no faults or other dislocations existed, it would, of course, make little difference where the tunnel was driven. Such homogeneous rock-masses are frequently found in text-books, but they are really quite rare in the outside world. Usually the engineer will find, on examining the ridge which faces him, that it is made up of several distinct kinds of rock, that these kinds of rock differ in hardness and other physical characters, and that different portions of the ridge probably show differences in the formation of the rocks. All of these facts will have some bearing on the cost of driving and operating the proposed tunnel; and it will be well to get some idea in advance as to how the ground conditions can be made to fit in best with the other requirements of the line. If a relatively slight shift in alignment is going to give cheaper work, either in constructing or operating, without bringing in any serious new difficulties, it will certainly pay to make the change.

Shale.—Cutting through shale usually means fast driving and cheap extraction, for the material breaks so readily that the quantity extracted per man or per pound of powder is commonly far higher than in any other rock. But when this is said, all the advantages have been mentioned. The final completion of the tunnel may be dangerous and expensive, and the cost of maintenance may turn out very high unless it is completely lined at once. In some cases, timbering must follow up close behind the heading, in order to prevent falling fragments and to retain the roof line. Shale is ordinarily full of closely set joint planes. On a freshly exposed surface, these may not show markedly, but exposure to the air induces "slaking," the joints open, and the shale breaks into fragments. Further than this, water is apt to be carried in quantity along some of the more strongly marked joint planes.

Slate.—The material reported as slate in the progress of the work may be a real roofing slate, but it is more apt to be a dense shale, breaking out in tabular masses instead of irregular fragments. In either case the driving is easy if the bedding or cleavage are in such an attitude that advantage can be taken of them; but work across the grain is difficult and expensive. There is less frequency of falls of roof during working than in dealing with other shales, but on the other hand the size of the falling masses makes the matter more serious when it does happen. If the bedding is vertical or nearly so, lining will usually be unnecessary; if the bedding is horizontal, falls may be expected to occur at intervals. The importance of the tunnel will then have to determine whether all of these should be guarded against from the outset.

Sandstone.—Sandstones vary widely in physical properties, from thin-bedded fragile materials that can be readily broken with a pick up to dense vitreous quartzites that will wreck all the tool steel on the job.

Quartzites are sandstones in which the original quartz grains have been cemented together by infiltrating silica. They are dense, resistant to physical and chemical changes, difficult and expensive to excavate. Fortunately, they occur principally in regions of extreme metamorphism, and are therefore common only in certain mountainous portions near the eastern and western coasts, and in the Lake Superior region. In steeply folded regions, the quartzites may be barely jointed. In this case their excavation is easier, but at the same time the joint planes give access to water.

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[*] Extracts from a forthcoming book on "Geology as Applied to Engineering Work."

[†] Assoc. Am. Soc. C. E., Consulting Geologist, Munsey Building, Washington, D. C.

Throughout most of the central and eastern United States, the sandstones found are reasonably dense, varying from stones like the Berea stone up to the much denser and tougher bluestones or flagstones. They give fairly cheap driving, especially where the bedding is in a favorable attitude, and make excellent roofs and sides. Taken as a group, sandstones of this intermediate type probably furnish the cheapest tunnel work, when construction and maintenance both are considered.

West of the 95th meridian, most of the sandstones encountered in the plains region and along the immediate Pacific coast are fragile, thin-bedded materials, readily excavated and yet commonly strong enough to hold position after the cut is driven.

Gneiss.—The banded metamorphic rocks, such as gneiss, schist, etc., will differ greatly in difficulty of treatment, the variations being due not so much to differences in mineral or chemical composition, as to the attitude of their banding or apparent bedding planes, the thickness of the plates or beds into which they are separated, and the presence and relative importance of joints. A gneiss lying horizontally or nearly so, and without frequent joints or thin banding, is perhaps more expensive to handle than any granite. On the other hand, a gneiss or schist whose banding is at right angles to the course of the heading will commonly break almost as readily as flagstone. In any case, except where joints are very numerous and open, the roof and sides will be secure. Water softening with lime and then allowing the turbidity to settle out, along with the precipitated carbonates. Turbid water has never been successfully disinfected with hypochlorite, because the bacteria imbedded in the suspended matter are not destroyed.

(7) The sterilizing action persists indefinitely. In a paper on water disinfection by chemical methods, Samuel Rideal states the advantages of using chemicals that persist in their disinfecting action, in the following words: "may enter either along the apparent bedding planes, or along joint planes; but ordinarily the quantity will not be serious."

Granite.—For convenience, all of the massive igneous rocks may be included here under this heading, and as a matter of fact most of them will be true granites or closely allied. Under ordinary circumstances, rock of this type will afford very expensive excavation, but good sound roofs and sides, and practically no water troubles, One point is worth bearing in mind. Granites do not have any bedding planes, and ordinarily show little banding or foliation. But even the densest and most massive looking granite will break with considerably greater ease in one direction than in another. This direction can only be found by experiment in each case, but it worth going to this trouble early in the work in order to secure extra efficiency in drilling and blasting operations later.

▩ *Limestone* ▤ *Sandstone* ▨ *Shale*

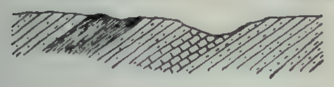

Fig. 1—Gap caused by erosion of softer rock.

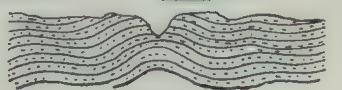

Fig. 2—Gap caused by erosion of weak crest of arch or anticlinal fold.

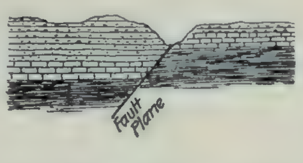

Fig. 3—Gap caused by erosion along weakened fault plane.

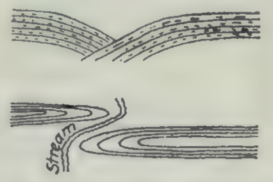

Fig. 4—Gap due to overlapping folds.

Limestone.—Limestones differ from all the roofs which have heretofore been mentioned, in a very striking and important way. The other rocks, from shales to granites, weather chiefly or entirely from an exposed surface, so that if the rocks exposed on the ground above the tunnel alignment seem fresh, there need be little fear of striking decayed rock in the headings. But limestone acts differently. It is very soluble, and water penetrating along joint planes or through the mass of the rock itself will gradually work out large channels or cavities to a great depth. These may remain open, or be partly filled up by "clay seams."

Limestone is an easily handled rock, and a sound thick-bedded limestone will make for cheap drivng and good roofs and sides. But in driving a limestone tunnel there is always the chance that the next blast will play havoc with all calculations by opening up a clay seam, a cave, or a water channel. The difficulty is not so much the increased expense, as the fact that the interruptions are unexpected and so hard to guard against in advance.

Owing to differences in composition, texture, bedding, position and climate, limestones show wide differences in solubility and cavity formation. Other things being equal, caves and large water channels are most likely to occur in a limestone lying horizontally or nearly so. On the other hand, steeply dipping limestones will frequently show clay seams extending from the surface downward for 50 ft. or more.

These facts may be used for guidance. If the ridge consists partly or entirely of flat-lying limestone beds, the presence of known caves in the same general region, or the existence of exceptionally large springs breaking out along the flanks of the ridge, should serve as a warning. On the other hand, if the beds dip at angles of 35 deg. or more, attention should be paid to their appearance along a line across the ridge over the tunnel alignment. The occurrence of bands of red or deep yellow clay, apparently interbedded with sound limestone, will in that case suggest that these seams may go deep enough to be encountered in the tunnel work.

Rock Folds.—It is but rarely that a tunnel passes through rock beds lying flat or nearly so, because low points in ridges do not usually occur in areas of horiontal and undisturbed rocks. Normally, the rocks will be dipping at fairly high angles, which may indeed approach the vertical. Normally, also, the strike or trend of the rocks will be more nearly at right angles to the course of the tunnel than parallel to it. These conditions arise from the general modes of origin of mountain ranges and passes.

Whatever the angle of dip, the rocks will break most readily from a bedding plane, slips and falls will commonly originate on such planes, and the chief water flows may be expected along them. The presence of numerous or very open joints may, however, operate to modify these conclusions. So far as work is concerned, if the rock beds dip parallel to the side of the ridge, the blasting will be least effective, and the water troubles greatest; if the rocks on the contrary dip into the mountain, the excavation work will be cheapest, though perhaps more dangerous; while the chance of heavy water flows will usually be slight. The chance of falls or slips will be least with horizontal or vertical rocks, and greatest with rocks dipping between 35 and 70 deg. or thereabout. Of course, allowances must be made, in reaching conclusions, for variations in the thickness, of the individual beds, and for differences in the tightness or openness of the bedding planes.

Contact Planes.—All of the features which characterize ordinary bedding planes are emphasized on those planes where two different kinds of rock are brought into contact. The chance of slipping and the possibility of water troubles are both present at such points. This is true even where the contact is an ordinary conformable one, both rocks having the same dip; it becomes still more important where the contact plane is marked by faulting.

Fault Planes.—Since the existence of a fault implies that there has been movement along its plane, the rocks on one side having been raised or lowered relatively to those on the other side, it can be seen that the fault plane and the zone of rock in its immediate vicinity are likely to offer engineering difficulties. When fracturing or brecciation of the rocks has accompanied the faulting, the effects may extend over a considerable zone, and their technical importance may be heavily increased. But even where there is no serious rock fracturing, the fault plane itself offers opportunities for easy rock movement, which may vary in intensity from simple roof falls to serious slips. And, in addition, the plane of the fault is likely to offer an easy passage for surface and subsurface waters.

For these reasons, a faulted zone is not likely to give cheap and safe tunnel driving, or cheap maintenance; and if it is possible to detect the presence of fault in advance, and locate its position on the ground, it will pay to go to considerable trouble to avoid its neighborhood, by shifts in either alignment or level.

A Discussion of Traffic Factors*

By J. Eastwood, A. M. Inst. C. E.

IN order to consider the relative merits of various forms of road construction, and to compare the results obtained in one road with the results obtained in another, it is necessary to have some standard of comparison of traffic. There are many difficulties in the way of fixing upon a simple, universal standard, and there is a danger of arriving at a false and misleading simplicity by ignoring many vital points. It will, however, be a real step forward if there can be agreed upon a standard which will hold good even within a limited area. Such a standard would be, as pointed out by the author in the correspondence on Mr. J. Walker Smith's paper,* of great value to the engineer in considering the question of improving the roads within the area, by affording an index to the durability, and hence the relative cost of various kinds of road construction under given conditions of traffic.

At one time it was considered sufficient in taking a traffic census to count the vehicles passing in a given time, but it has long been recognized that such a method of enumeration is useless for comparing a mixed mass of traffic passing along a given road with a mixed and possibly very dissimilar mass of traffic passing along another road. The late Mr. G. F. Deacon proposed to reduce traffic to a standard of tons per yard width of roadway per annum, and this is a system which has been largely followed, the Form of Summary of Statistics of Traffic issued by the Road Board being based on this method. While this is a great advance on the previous method, it does not take sufficient note of the character of the traffic and of the road surface.

A little consideration will lead to the conclusion that many other factors besides weight have an influence in determining the destructive effect of traffic on road surfaces. To take an instance which occurred within the author's experience: On a certain road which was paved with granite on concrete foundation, and had a gradient of 1 in 22 to 1 in 13, there was considerable motor wagon traffic to a neighbouring factory, a motor wagon with steel tyres passing backwards and forwards frequently, usually with a full load on the down journey. Under these conditions the life of the granite was from two to three years only, the setts being crushed to pieces. The steel tyres were then removed and rubber ones substituted, with the result that the life of the paving was more than doubled, though the traffic in tons per yard width per annum was practically the same throughout the period. Again, compare the destructive effect of a motor car with steel-studded tyres travelling at a fast speed on a macadamized road with that of a heavy motor wagon with rubber tyres passing slowly along a paved road. Mr. Walker Smith in the paper previously referred to says:—

"It will no doubt be readily granted that upon macadam surfaces a 10-ton traction engine will do more damage than ten units of 1 ton each; but here again the extent of the relative damage will not be constant, as the extra damaging effect per ton of the heavier vehicles will decrease as the strength of the road increases, and, apart from questions of weight, all rubber-tyred vehicles—particularly heavy fast-running motor vehicles—will have a more detrimental effect upon the surface of a water-bound road than upon the surface of a bituminous-bound road. It would therefore appear to be necessary, in order to standardize traffic effects, to lay down coefficients of potential damaging effect."

To this it may be added, as a necessary corollary, that the vehicles mentioned will also have a more detrimental effect upon macadamized roads generally than upon paved surfaces. In correspondence on the paper, Mr. Walker Smith again reiterated that he did not agree that coefficients of potential damaging effect should be based on the intensity of weight on the road.

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* Abstract of an article in The Surveyor, (London).

It is the aim of this paper to discuss the conditions influencing the value of coefficients of potential damaging effect, or, as some American engineers call them, "traffic factors," a term which the author has adopted as being not quite so cumbrous as the other. The author has already enumerated some of these conditions in the correspondence on Mr. Walker Smith's paper, in which he also quoted factors suggested by Major Crosby, chief engineer, Maryland Geological and Economic Survey, and the New York State authorities. It will be seen, therefore, that the author is not advancing any novel suggestions, but rather elaborating previous ones, particularly the combining of leading features of both the method of traffic factors and that of the standard of traffic per unit width, by dividing the total traffic number by the width of the road in order to allow for difference in width, as suggested in the above correspondence.

It will be evident that the ideal table of traffic factors will contain factors for each class of traffic on every kind of road surface, and under all variations of conditions which are seen to affect the value of such factors. Such an ideal table is naturally unattainable, and if attainable would be too complicated to be of value. The tables of the American authorities, above cited, refer only to ordinary macadamized roads, while the tables in Mr. Walker Smith's paper refer to such roads, and also to macadamized roads with bituminous binding. In the present paper factors are proposed for certain classes of traffic for both macadamized and paved roads. These values are such as the author's present experience lead him to consider suitable, but owing to the lack of sufficient data they are only suggested as tentative figures to be modified in the future as experience may indicate to be necessary, as it is apparent that a table of traffic factors must be an empirical one, and must be continually checked and readjusted as fresh data are forthcoming.

The following considerations will all bear on the question of the wearing effect of traffic on road surfaces:—

Road.—Surface formation, foundation, gradient.
Class of Traffic.—Weight, intensity of weight, description of tyres, speed, method of shoeing in the case of horses.
Weather Conditions.
Width of Road.

The method of arriving at suitable traffic factors for various classes of road surfaces is as follows: Typical roads are selected where the effects of foundation and gradient may be neglected, and it is found that, comparing macadamized surfaces in one part of these roads with paved roads of different kinds in other parts of these roads, and subjected, as nearly as can be judged, to the same traffic, the lives, say, of granite macadamized roads, York stone paving and granite paving are in the ratio of 1:2½:6. If then factors for the different kinds of traffic passing over these roads can be agreed upon, say, for macadamized roads, it becomes an easy matter to deduce from these factors for other classes of road surfaces, provided a reliable traffic census is available. In the supposed case it will not answer the purpose merely to alter all the factors in the same proportions. The results of the census must be taken, and the various factors adjusted by trial until the total traffic numbers for the various classes of surface are inversely in the agreed ratio of the lives of these surfaces. A comparison of the various values given in table 6 wil make this clearer.

The question of road surfaces generally has been referred to in the preliminary remarks. A few other points affecting traffic factors may now be briefly referred to.

Foundation

Closely allied to the question of surface formation is that of foundation, and the destructive effects of heavy traffic—especially heavy traffic per unit width of tyre—or of fast motor traffic with studded tyres, on macadamized roads without proper foundation are well known. There is another aspect of foundation which is perhaps not so well recognized, and that is the effect of a rigid foundation, such as concrete, in holding up the surface to the pounding action of fast-moving steel-tyred motors or similar heavy traffic. The road surface is then literally between the hammer and the anvil, and if the force of the impact exceeds the crushing resistance of the material the result is disastrous—as, for example, in the case of the granite road referred to earlier, where the setts were crushed to pieces in from two to three years. Similar cases occur with gritstone paving, even when not on concrete, provided the bed upon which it is laid is fairly solid.

The effect of a bad foundation cannot be allowed for in a standard table of traffic factors as the questions of degree and nature of defects then arise. The object in drawing attention to it here is to emphasize the fact that in gathering data for constructing such a table care must be taken that the observations are confined to roads where the foundations are such that the results will not be vitiated by them.

Gradient

The damaging effect of horse traffic, in particular, is considerably increased by heavy gradients, the digging and pounding action of the horses' feet in drawings loads up the hill being very destructive of the road surface. On macadamized roads it loosens the surface and digs out the stones, while in wet weather the surface, being soft, is pounded to a pulp and the stones rounded in such a way that disintegration in dry weather is greatly facilitated. With paved surfaces the horses can only get a good foothold in the joints of the setts, and consequently wherever their shoes first strike the surface they slide downwards until they reach a joint, and the faces of the setts are soon so rounded that the horses can only obtain a foothold with difficulty.

In a particular instance York stone paving on a gradient of 1 in 9 had in twelve months worn down 1½ ins. at the middle of the sett to 3 ins. at the joint on the up side of a street in which on the down side the life of the paving was about four years. The up traffic was confined to one line, owing to metal plates having been placed for the wheels of vehicles to run upon, and consequently the whole of the above-mentioned wear was due to the horses' feet. The down traffic also tended to keep mostly in one line, as many of the vehicles had slippers on one wheel, and ground against the kerb with the other to act as a brake.

Generally speaking, in several cases where, owing to tramway lines in the centre of the road, or other causes, the tarffic up and down roads having a gradient of 1 in 9 to 1 in 14 or so has tended to keep each to its own side, the life of paving on the up side has been from one-half to one-third of that on the down side, owing to this rounding of the setts.

In the accompanying tables an arbitrary division has been fixed upon at a gradient of about 1 in 14, and different factors are given for roads steeper and for roads flatter than this. It will be understood that there is no sharply defined difference between what happens on a gradient of 1 in 14 and on a gradient of 1 in 15. The effect due to gradient increases gradually as the gradient increases, and since the line must be drawn somewhere, it was thought fair to draw it at a gradient of 1 in 14, though this is entirely a matter of opinion, and it may be that this arbitrary division should vary with the nature of the road surface.

Class of Traffic

The weight of vehicles, and more especially the intensity of weight, must have consideration in drawing up a table of traffic factors, as, other things being equal, a fast moving vehicle will do more damage than a slow moving one. Some authorities are of opinion that weight multiplied by speed would give a good basis for traffic factors for self-propelled vehicles, but this seems too severe upon light fast moving vehicles, though this, again, will depend somewhat on road surface, tyres, and so on. Since a vehicle is not always loaded up to its utmost capacity, nor always driven at its utmost speed, it is possible to attach too much importance to considerations of weight and speed. The influence of possible speed on the traffic factor will vary with the locality. On heavily trafficked urban or suburban roads a vehicle will not as often approach its speed limit as on a rural road, so that what seems to the town surveyor to be a suitable factor may appear unsuitable for a rural district.

It will scarcely be necessary to enlarge on the question of tyres, as it is plain that different tyres—rubber, rubber studded with steel, steel, and steel with transverse bars, as in traction engines—have widely varying effects on road surfaces.

In the case of horse traffic the damage to the road surface depends a good deal upon the method of shoeing. In many towns in the North having steep gradients, the horses, especially heavy horses, are shod in such a way as to give them a better foothold, and, incidentally, to damage the road surface much more than those which are flat shod. In summer they are shod with toe-bits at the front of the shoe and caulkers at the back. For a heavy carthorse the toe-bit is an oblong piece about ⅝-in. square and 4 ins. in length, fixed across the toe, and the caulkers are about 1¼ ins. square, and project about ¾-in. from the face of the shoe. In winter the horses are shod with plug shoes, having four holes into which steel plugs can be driven. These plugs project ½-in. to ¾-in., and newly sharpened plugs are inserted on the appearance of frost. Should the frost be of short duration, followed by a quick thaw, the effect of these plugs, both on macadamized and paved surfaces, is very severe.

Weather

Where the atmosphere is generally humid, and there is a considerable proportion of wet days, the damaging effect will be greater on roads generally, and particularly on water-bound roads, than in the case of a drier atmosphere and with fewer wet days. It is not so much a question of comparing rainfall as the number of wet days and the general humidity.

Width of Road

The author proposes to allow for variation in width by dividing the total traffic number by the width of the road. If, however, the road is so narrow that there is only room for two lines of traffic, the effect of the traffic is greater than would be indicated by the ratio total traffic divided by width, owing to the surface becoming rutted. Cases which have come under the author's notice include one in which granite paving, owing to this cause, had a life of two to three years only as compared with ten years with the same traffic under ordinary conditions, and another in which gritstone paving had a life of four years, as against eight years under ordinary conditions further along the same road. This, however, is one of the local influences for which special allowance must be made, and which is outside the scope of a general table.

It will be seen that the question of traffic factors is a complicated one, and one which can only be simplified by careful observations, continued over a long period. Unfortunately, this research is costly, and it would be difficult to persuade local authorities having charge of roads that it would be of sufficient value to repay the cost.

Tile Work Decoration

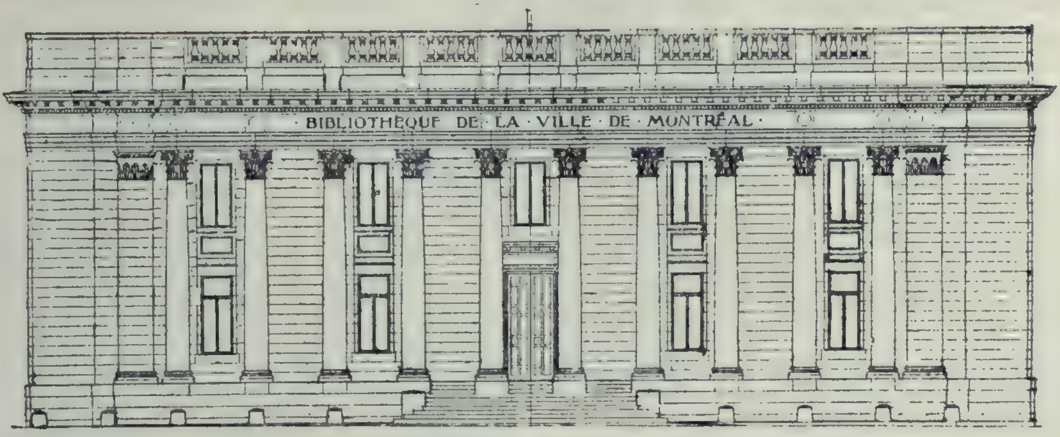
IN the course of a very interesting paper on "The Architecture of Portugal," read before the London Architectural Association by W. H. Ward, associate member of the Royal Institute of British Architects, and illustrated by a large number of lantern slides from photographs taken and plans made by the author, the following comments were presented dealing with tile work decoration.

Perhaps the most obvious and enduring effect of Moorish tradition lies in the use of tiled linings. The manufacture of colored glazed tiles in the East is almost as old as history. It was introduced into Spain by the Arabs, perhaps as early as the eighth century, but no existing examples can be proved to be earlier than the thirteenth. Their beauty of color, and the cool expanses of floor and wall surface which they provide, so grateful in the torrid heats of summer, earned them a wide popularity in the Peninsula which they have ever since retained.

In the earliest examples the tiles are self-colored—either bluish-green, brown, dark violet, or milky-white, and of various shapes, and they are laid in geometrical patterns. Later on, a process was invented of producing a pattern on single tiles, by cutting a design in incised lines on a wooden stamp, which was reproduced in raised lines on the soft clay; color being then run into the intervening spaces.

The designs were usually of the star type, but grotesque animals and flower and foliage motifs were sometimes introduced; a little later embossed tiles, especially in vine patterns, came into use. At Cintra are several rooms decorated with high dadoes of some of these kinds of tiles, some of them being finished with cusped and crocketed crestings. The tiles used are mostly self-colored, or nearly so; but the old cathedral at Coimbra exhibits fine examples of patterned tiles of the fourteenth century clothing the walls, and, till the recent restoration, also the piers, while a bewildering variety of rickly-colered devices produces a tapestry-like effect.

At the Renaissance the star paterns were supplemented by scroll and other flowing ornamentation, and the range of color became more varied, being painted on the tiles without bounding ridges. The patterns are sometimes continuous, covering the whole walls, as in the seventeenth- century sacristy of Sta. Cruz, or enclosed in architectural borders, as at Sao Amaro at Alcantra. About the same time lustre tiles



Proposed Civic Library, Sherbrooke Street East, Montreal. Architect, Mr. E. Payette.

—first pale gold and, later, red gold—also came into use.

But after the expulsion of the Moors in 1609 the art of the tile-maker gradually declined, the colors lost in brillance, and their range became restricted to blue designs on white grounds, with purple and yellow as occasional variants. The blue-and-white technique seems to have arisen simultaneously at Delft and in Portugal, and in each case seems to be the outcome of a desire to imitate Chinese porcelain, then becoming known in Europe. Many of these tiles had a single flower vase or figure subject on each.

The practice, however, of making large figure subjects in ornamental borders, with a portion only of the total design painted on each individual tile, came in during the sixteenth century and continued till the early nineteenth. An example occurs in the nave of Sta. Cruz at Coimbra. Tile linings were applied, not only to rooms, but to cloisters, tanks, steps, garden-seats, and even roofs, but their use for entire house-fronts, now common in Portuguese towns, seems to be no earlier than the nineteenth century; and that is, it came in when both the color and the design of the tiles had sunk to insignificance.

New Civic Library for Montreal

THE Montreal City Council have approved the plans of Mr. E. Payette for a civic library to be erected on Sherbrooke Street East, between Montcalm and Beaudry Streets. The frontage of the building on Sherbrooke Street will be 115 feet, and the depth, to both Montcalm and Beaudry streets, 210 feet. The building will be of stone, with a granite base, and will have an eight-foot portico, embellished by ten polished monolith marble columns. The height of the facade on this side is 50 feet 6 inches from the sidewalk. The main distributing hall, approached by a short flight of steps and through an artistic entrance, will be 28 feet by 56 feet and 33 feet high. On the left of this hall is the general reading room, 31 feet by 110 feet, and on the right, the newspaper and magazine room, librarians' office, cataloging and stock rooms.

Wide staircases from either side of the vestibule lead to a gallery on the second floor, from which is reached the art, patent and map room; exhibition room, which will be devoted to works of statuary and paintings by local artists; and the Canadian room, where several valuable collections will be placed.

The ground floor, approached from Montcalm Street, distinct from the other entrances, will be set apart for the use of children. The reading room will be 78 feet by 38 feet. On this floor will also be found the bindery, stationery, warehousing and cloak rooms. In the basement, provision has been made for the janitor's apartments, ventilating plant, heating apparatus and cellarage.

The Council have awarded the contract for constructing the foundation of the building to the Foundation Company, Limited, Montreal.

Concrete as a material for gate structures in American irrigation canals is beginning to displace wood, its durability overcoming the disadvantage of higher cost. Bulletin No. 115 of the United States Department of Agriculture purposes to submit to engineers such designs for gate structures for controlling the flow of water in ditches or canal systems as are adapted to different localities. Small and medium-size structures, for the most part, are described in the new bulletin. It does not attempt to exhaust the subject, but merely gives examples of structures which have satisfactorily served the purpose for which they were erected. As regards material, the opinion of the investigator seems to be that a structure of combined wood and concrete, using the latter for inaccessible parts and wood for easily replaced parts, is the best practice.

According to a design now being introduced by an Italian firm, reinforced concrete sleepers are constructed as girder beams having at each cross-section between the rail seats a resistance uniformly proportionate to the bending stress there. The central reinforcement consists of iron ties, one row at the top and another row at the bottom, interconnected or with two such rows, the inner rows being crossed, and the sleeper having triangular or rectangular openings corresponding to the ties. The rails rest on elastic lugs, free at one end, or on a platform at the upper end of a post of reinforced concrete. To vary the gauge, the bolt holes correspond to a frustum of a pyramid or cone on an oblique prism or cylinder, and bolts are used having a shank shaped to fill the hole wholly or partly. Openings in the sleeper give access to the nuts.

New Police Headquarters, Vancouver

An outstanding example of recent building construction at Vancouver is the fine new structure at the corner of Gore Avenue and Cordova Street, wherein is accommodated the police headquarters of the terminal city. The work bears numerous evidences of having been carefully planned to the minutest detail with the object of fulfilling the peculiar and exacting requirements of a building of this type, and in the strictly utilitarian sense, as well as from an architectural standpoint, it admirably conforms with the purpose for which it was intended.

The ground space occupied measures 100 x 122 feet and the height is five storeys with full basement. The construction is fireproof, comprising reinforced concrete and steel. The main footings have been carried to hard pan at an average depth of 14 feet below grade, but in the North East corner of the site it was found necessary to excavate from 10 to 12 feet below the depth of the main footings before hard pan was reached. The height of the basement is 10 feet 6 inches and the basement walls measure 13 inches in thickness.

The building has been designed to carry three additional storeys at some time in the future and on this account the construction across the wide spans such as the court rooms and parade rooms, was made especially substantial, a 40-foot 6-inch steel span being provided in the court room, while the length of the parade room span is 40 feet. The foundation work is also unusually heavy and the extra thickness of the columns is noticeable, the basement columns measuring from 22 x 22 inches square to 24 x 24 inches square, decreasing in strength of course in the upper storeys.

All outside walls above the basement consist of an 8-inch thickness of Dennison hollow tile and a 4-inch outer lining of brick. Tapestry brick, Roman size, distinguishes the front elevation on Cordova street, and buff colored pressed brick is employed for the side and rear elevations. The interior walls are tile, with the exception of the partitions enclosing the cell rooms, which are of heavy reinforced concrete construction.

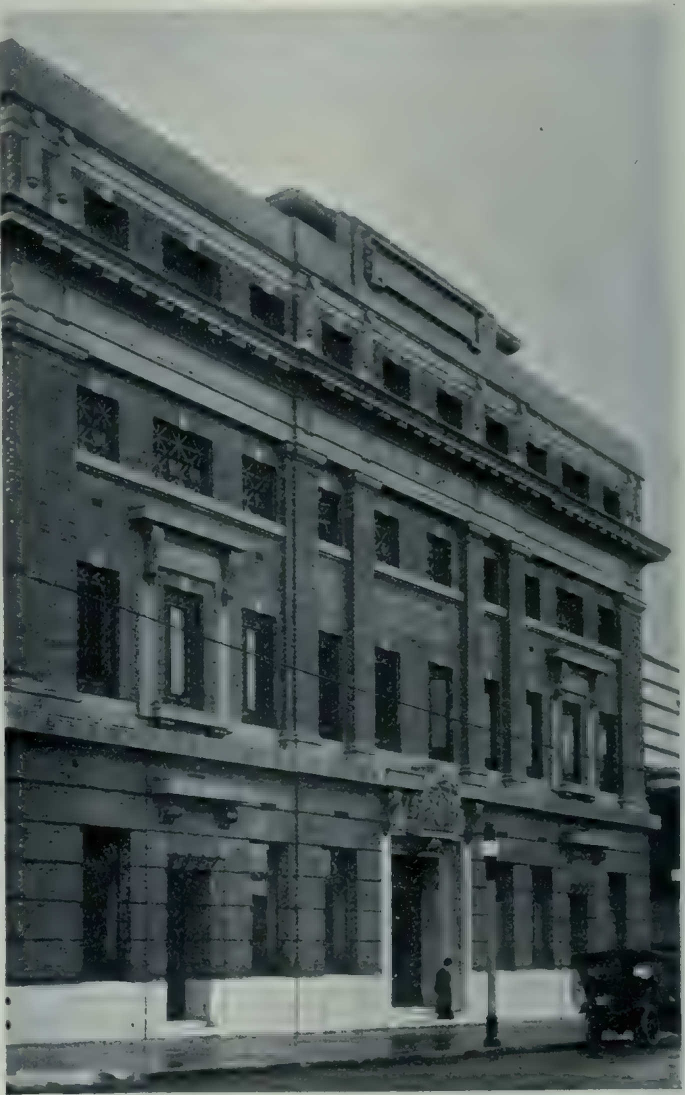
The majority of the floors consist of steel floretyle and concrete but in some parts of the building the floors are of solid reinforced concrete slab. In the former style of construction, floretyle 8 inches thick is used, on top of which is a 2½-inch layer of concrete with a cement finish. The concrete slab floors are 6 inches thick on the average and finished with a coating of cement.

The roof is also of 6-inch concrete slab but with a tar and gravel covering. The surface of the roof to the leaders has been graded with cinders grouted with cement, and tar, felt and gravel laid on top. The waterproofing of the basement, under the foundations as well as on the concrete floor, and up to grade at the sides was treated similarly to the roof.

The building is heated by the vacuum steam system with fuel oil burning plant. The ventilation is on the extradition plan, the pure air entering the building over radiators placed in the various rooms and the fuel air extracted by a large fan placed in the roof where the air is conveyed by means of galvanized iron ducts of No. 24 gauge. The fan is of the Multivane type, capable of delivering 14,000 cubic feet of air per minute, and is operated by an electric motor to which it is belted. The motor is a 10 h.p., 1,120 r.p.m., 220 volt, 60-cycle, 3-phase motor complete with bed plates, switches, etc.

The treatment of the front elevation has been carried out in the classic style of architecture with brick and cream colored terra cotta relief. A granite base extends from grade to the windows of the first floor. The base of the pilasters at the sills of the second-storey windows is formed by a band of terra cotta, two feet thick. This is succeeded by brick treatment to the entableture on the fourth storey floor level, and brick and terra cotta work from there to the roof.

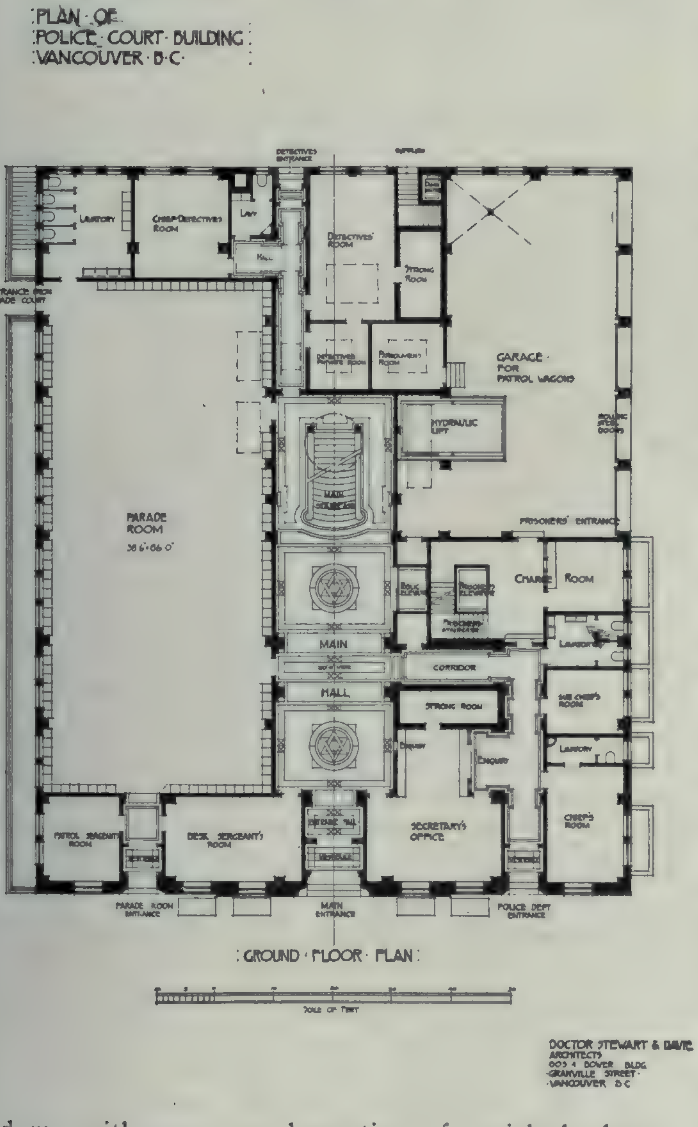
Three entrances are provided on the Cordova street frontage. The main or public entrance leading to the main hall is surmounted by an attractive design of the Vancouver Coat-of-Arms. treated in terra cotta The outside doors are of oak studded with heavy bronze studs. Above the doorways are an ornamental iron grille 1½ feet in height. The decorative effect on the exterior of all entrances is in terra cotta.



Front elevation, Vancouver's new Police Headquarters.

The windows throughout the building are fitted with steel sash. Those extending along the front elevation on the ground floor are in police departments and have wrought iron grilles, as also have the windows of the court room on the second floor. Bars of strap iron protect the windows of the cell rooms on the third floor.

The interior arrangements are of the most complete description and the decorative effects, especially in the lower floors, are extremely lavish. Laurentian marble wainscotting has been provided in the main hall to a height of 8 feet 6 inches, and in the entrance vestibule this trim extends 10 feet high. Massive pilasters of this material reach from floor to ceiling at each side of the doorways in the entrance hall, a height of about 12 feet. The stretch of wall between the top of the marble panelling and the ceiling is treated in raised plaster panel. The ceiling itself calls for no special comment being carried out with a view to simplicity. The floor of the entrance vestibule is laid with terrazzo tile with inserts of various colored marbles. The main staircase leading from the ground floor to the first floor and decorated with marble has a wrought iron balustrade. Over the staircase is a large steel dome with generous decoration of enriched plaster and ornamental stained glass, from which is suspended a handsome electric drop light. The volume of daylight entering thorugh a five-light stained glass window on the staircase landing and also by way of the dome is of sufficient power to ensure admirable lighting in the vicinity of the hall and staircase during the daytime.



GROUND FLOOR PLAN

There are two court rooms on the first floor each measuring about 40 feet x 40 feet. Both rooms are treated with an oak dado 7 feet high which extends around the walls forming a base to the plaster pilasters which are carried to the ceiling beams. The woodwork behind the judge's bench is carved oak, and the remaining interior wood finish as well as the furniture is also of oak. The ceiling is carried out in a simple scheme of enriched plaster.

A first rate idea of the general layout on the main floor can be gained from a careful study of the accompanying plan. As will be gathered from the drawing two of the main divisions on this floor are a parade room, measuring 38 feet 6 inches x 86 feet and a large garage where careful provision has been made for the care of the numerous motor vehicles used by the police department. The principal features of the first floor are the two court rooms which have already been described. Adjoining these are judge's and witnesses' rooms, and prisoners' waiting corridor, the latter communicating with cells. The upper hall occupies the centre of this floor and the general offices of the police department as well as apartments for detectives have been placed at the rear. The court rooms occupying the height of two full storeys take up the space at the front of the second floor and the remainder of the space, with the exception of a public hall, has been given over to prisoners' cell rooms of which there are 40 on this floor alone. The cells all face windows having only a corridor about 6 feet between the barred cell door and the barred windows which provide plenty of light and air. The doors of the cells are operated from a lever box in the guard's corridor, the lever equipment being of the latest type and capable of controlling the movements of any number of doors at a given time. Consultation rooms, guard rooms, etc., and lavatories and toilets for prisoners are also provided on the second floor. The third floor contains cells with connecting apartments and male and female hospital wards, the lighting and airing of the latter being particularly effective. There are 67 cells on this floor. They are of the double portable steel type providing accommodation for twice that number of prisoners. On the fourth floor are situated the city health and analyst's departments. Also a kitchen, measuring 40 x 24 feet with usual accessories for preparing meals for prisoners, photographic department, museum, gymnasium, 70 x 31 feet, with dressing room and lavatory accommodation for the use of constables, and tailor shop.

Grouped around the lower hall in the basement are locker rooms, electricians' department where is installed the operating board for a comprehensive and up-to-date police patrol system, and the police telephone exchange, room for linemen, stolen property room with fireproof vault in connection, cell accommodations for 18 prisoners, workshop for repairing motor vans, etc.

In addition to two electrically controlled elevators with which the building has been equipped, there is one hydraulic elevator for raising and lowering motor vans between the garage and the workshop.

Vancouver's new police station was designed by the architectural firm of Doctor, Stewart & Davie, of that city, and C. F. Perry, a local contractor, carried out the general contract.

The building was completed towards the latter part of the summer and represents a total outlay of approximately $257,000.

"Business as Usual" as a motto seems pretty hard to beat, but here is an improved version of it which has been adopted by Messrs. Gent & Company, Limited, wholesale manufacturing electricians of Leicester, England, whose products are well known in Canada:—**"Business as Usual, but More Of It."**

Sewage-Disposal Works in European Cities

By George E. Datesman*

THROUGHOUT England, where rivers are comparatively small, sewage disposal plants are undergoing reconstruction, and some form of bacterial treatment in beds is being added to the preliminary treatment. In some cases it has been found to be economical to turn the earlier works into scrap and build entirely new, as at Leeds. The disposal of sludge, except where it is carried to sea, has been generally inadequate. This is now considered by many the most vital problem. In Germany by several processes the problem of sludge disposal has been sucfully solved.

As to the present status of the art the following statements may safely be made:

Sewage, even of exceptional concentration, can be effectively treated so as to secure a clear, odorless, sparkling, non-putrescible effluent before discharging into a stream the securing of which is a matter of cost and therefore an economic as well as a constructive problem.

Sludge resulting from sewage treatment can be rendered innocuous, practically inodorous, wholly unobjectionable, after which it may be dealt with in various ways.

Desired results may be secured by certain combinations of treatment at a fraction of the cost of other recognized scientific methods of treatment in satisfactory operations.

In general it is cheaper to treat water, when practical disinfection can be secured, by the admixture of from 0.3 to 0.7 p.p.m. of available chlorine instead of attempting to secure an uncertain comparative result in the treatment of sewage effluent by the admixture of from 2 to 6 parts, with a probability of having to resort to an equal amount of treatment for the water notwithstanding the sewage treatment.

Notable as being the best of their kinds are the following works, listed according to methods used: Hamburg, screening and dilution in the Elbe; Dresden, grit chamber and fine screening with dilution in the Elbe; Vienna, efficient collecting systems with dilution in the Danube; Frankfort-on-Maine, grit chambers, screens, settling tanks, sludge dried in centrifugals, further dried by heat and burned under boilers to produce electric current; Wilmersdorf, primary settling tanks, percolating filters, secondary tanks, sand filtration, sludge in lagoons; Cologne and Dusseldorf, fine screening and tankage, with dilution in the Rhine; Berlin and Paris, farms; London, screens and tanks, with dilution in the Thames; Manchester and Sheffield, screens, tanks and contact beds; Birmingham, detritus tanks, settling tanks and percolating filters, sludge in lagoons; Salford, grit chambers, settling tanks, roughing filter, percolating filters, sludge mixed with chemicals, pressed and dried. Many others will outclass these when new works shall be in operation.

The quality of material and workmanship in sewer construction are superfine, due in a measure to mechanics' wages being one-third of ours.

Percolating filters and their operation may be best studied in England. Scientific experimentation on this system has been more thoroughly carried out in Paris. The investigations upon river dilution have been carried on thoroughly in Germany. Sludge disposal, except where it is carried to sea, has not been solved in England.

The English sanitary world is hopeful that we are on the eve of developing a more intensive, economical and effective means of treatment than the percolating filter.—Engineering Record.

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*Principal Assistant Engineer, Bureau of Surveys, Philadelphia.

Consistency of Concrete

For the foundation and walls of buildings, enough water should be used in the concrete so that it will flow to all parts of the mold with a small amount of puddling and spading. For columns, beams, floor-slabs, and roof-slabs, the mass should have a quaky consistency such as will tend to flatten out of its own weight when piled. The mortar surface of floors should be mixed with sufficient water to make it work easily, but an excess of water should be avoided. Concrete blocks, sills, and lintels should be mixed just as wet as possible with the block machine employed. Blocks and sills made of a mixture wet enough to be quaky when placed in the mold, will be dense and water-tight. Blocks made with dry materials are porous, lack strength, and present a dead appearance. It must always be remembered that the bonding quality of cement in concrete depends upon a hydraulic action between the cement and the water, in which each plays an equally important part. The lack of sufficient water to complete this action is therefore as detrimental as the lack of cement.

Dynamite inserted in lengths of condemned fire hose was used to cut to pieces the steel drill barge "Teredo" which had been sunk at Panama by an accidental explosion. It having been found impracticable to raise it, it was decided to cut it to pieces. The hose with its charge of explosives was placed along the line at which it was desired to direct the force of the blast and, according to the "Canal Record," made a fairly clean cut. The sections sheared off were raised by wrecking barges assisted by a dipper dredge.

The damaged portions of concrete floors which have been chipped or cracked by hard usage may be chipped out with a chisel and mallet to a sufficient depth to reach the bottom of the deepest break. The rough surface is then treated with acid so as to bring out the solid aggregate, or a stiff brush is used to remove all the loose dust. The surface is washed out with a hose, and when all the dust and traces of acid have been removed, the recess is grouted with cement. Before the latter has set granolithic finish is applied and levelled up with the rest of the floor.

At the 25th annual convention of Ontario Association of Architects, held recently in Toronto, the President, Mr. C. H. Acton Bond, declared it to be the duty of architects to promote additional employment by substituting stone for terra cotta wherever possible. In using stone they were patronizing a home industry and the general policy advocated by him would help materially during the war period. The suggestion received the unanimous approval of the meeting. The affairs of the Society were shown to be flourishing. At present the membership is 172, an increase over last year of 32, while the finances of the organization are in better condition than ever before. The Toronto city improvements suggested by the Civic Guild were explained to the meeting by Mr. Edmund Burke and Mr. Frank Wickson.

The Durability of Creosoted Piling*

REMARKABLY short life is attributed to untreated Douglas fir piles in San Francisco and southern California ports, about 2½ years being considered by some engineers the longest that should be expected. Other engineers who have had more satisfactory experience with the untreated piles place its probable average life in service, other than in fender lines, at from 4 to 6 years. It is significant that 100 per cent. of all the untreated piles driven since 1906 by one railroad company in four Pacific Coast ports had to be replaced within 7 years. It is, therefore, generally agreed that some form of treatment is necessary if wooden piles are to be used in the more permanent structures; and, after considerable experiment, treatment with creosote has come to be the only method now used extensively on the Pacific Coast.

The question as to whether it is economical to continue treating piles, now that creosote costs 10.04 cents, as against 7¼ cents per gallon in 1912, was recently sent from the manager's office to the engineering department of a large company. The engineer showed in reply that a 1-cent increase in the price per gallon of creosote would increase the cost of the treated piles 1 cent per linear foot, and that, taking the life of untreated piles at 8 years and creosoted piles at 30 years, it would be economical to treat piles until the cost of treatment reached 32 cents per linear foot, which corresponds to a creosote cost of 22 cents per gallon. These figures are based on a cost for untreated Douglas fir piles of 10 cents per foot, as against 30 cents for creosoted piles. Assuming $6 for driving in each case, a 40-foot untreated pile in place would be worth $10 and a treated pile of equal length in place would cost $18.

The life of a treated pile will be determined largely by the condition of its outer surface after it is driven. Mechanical injuries, such as result from hooks, spikes or hammer blows, are to be carefully avoided, but even more serious than these is the checking that may result from treatment or that may develop in driving. In addition to the weakening and the exposure to the teredo due to checking, a new danger was discovered recently in Wilmington harbor. In this case piles which had checked considerably were found to be fairly sound on the surface, but within had been cut into "lacework" by borers much smaller than the teredo. Sections of these piles were submitted to experts to determine whether some hitherto unknown marine borer had attacked them, but careful examination showed the borers to be the common limnoria, which had abandoned its usual method of cutting around the exterior and had gone inside through cracks in the otherwise well-protected surface.

On the other hand, an instance of exceptionally good surface protection is found in the long wharf at Santa Monica. Piles in this structure were treated and driven in 1892 and at present the outer end of the wharf is no longer in use and is being removed by breaking the piles off at the ground line, about 55 feet below the surface. After 22 years of service most of the piles removed are being sharpened and redriven in the repair of bents beneath an electric railway track, and the foreman of the redriving crew reports them less liable to break under the hammer than freshly treated piles.

Total Annual Charge Against Creosoted Pile Piers

Interest charges at 4 per cent.	$0.0400
Annual maintenance	.0500
Replacement fund, 20 years	.0336
Redemption fund, 75 years	.0022
Insurance	.0060
Total annual charges per sq. ft.	$0.1318

The specifications for creosote approved by the American Railway Engineering Association are accepted as standard. Some form of boiling process is now used almost exclusively in the treatment. The boiling process was developed in 1892 by John D. Isaacs for the Southern Pacific Company, which treats a large percentage of the piles used in central and southern California. The process became generally known, and at present five of the six timber-treating plants in Oregon and Washington employ it.

In this process, which was designed primarily for treating Douglas fir, the artificial seasoning by boiling in oil is said to weaken the timber much less than the steaming process. After the piles are run into the treating cylinder on trucks, creosote at a temperature of 160 degrees Fahrenheit is introduced until the piles are covered and there is a space of 10 inches between the surface of the oil and the top of the retort. Steam is then admitted to coils in the cylinder and the temperature of the oil is raised to 220 degrees. The amount of steam is then regulated so as to maintain the temperature between 220 and 225 degrees until such time as the amount of condensation collected from the treating cylinder has decreased to ⅛ pound of water per cubic foot of timber per hour. After this the treating cylinder is filled with creosote at a temperature of 180 degrees and a pressure of 5 pounds per square inch is developed. Connection is then made with a measuring tank from which oil is pumped into the cylinder until an amount equal to 10 pounds for each cubic foot of timber has been injected.

Creosoted pile piers of the construction standard approved for the port of San Francisco by the Board of State Harbor Commissioners are usually estimated at $1 per square foot of completed pier, exclusive of bulkhead wall and sheds. This allows a margin for fluctuating prices of materials, as is shown by the fact that contracts for two piers have recently been let on a basis of 84 and 81.4 cents per square foot. On the basis of a cost of $1 per square foot the maintenance estimate in the accompanying table was submitted to the San Francisco Chamber of Commerce by a committee of three engineers appointed to investigate dock costs and governing conditions at the port of San Francisco.

It is apparent, therefore, that aside from any comparisons with concrete construction, creosoted piles can be expected to give satisfactory service under Pacific Coast conditions. Moreover, sufficient time has, probably, not elapsed to allow final judgment to be passed in the controversy between timber and concrete under these conditions, for, as above noted, piles which have been removed were giving good service after 22 years of use, while others are still in good condition after a period of 24 years.

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* By N. A. Bowers in the Engineering Record.

Fire Prevention

Danger Zone—Building Codes—Private and Public Fire Extinguishing Appliances—Control of Occupancy Hazard—State and Municipal Laws

THE Committee on Fire Prevention of the American Society of Municipal Improvements (of which Mr. Alcide Chausse, Building Inspector, Montreal, is Chairman), presented at the convention of that society as its report, a statement of the resolutions adopted and discussions held at the First American Fire Prevention Convention. Omitting the introductory paragraphs, the report is as follows:

Topic No. 1—"Location" (Exposure Hazard).

Note—Every building, and its contents in life and property, must stand on some finite, geographical spot; and carry to, and receive from, its environing property measurable fire hazards—hence this fundamental unit consideration.

Resolution.—It is the sense of this convention that:

Fire is always local, originating from a definite cause in a definite property on a definite location; hence every building—in reasonable relation to its size, character, use and the congestion of its location—should be so constructed as to prevent the passage of fire from within to without and vice versa.

Topic No. 2—"Zones of Danger."

Note—The aggregate unit fire exposure becomes communal fire exposure—hence the consideration next in order of groups of unit exposures.

Resolution—It is the sense of this convention that:

Populous communities should be divided into danger zones; wherein rules reasonably limiting, defining and regulating the presence, form and use of property may be legally imposed, with due regard for the present and near prospective congestion of life and property in such areas.

Topic No. 3—"Building Construction."

Note—On any selected site the consideration next in order is the unit building fire hazard—in design, specification and construction.

Resolution—It is the sense of the convention that:

All building construction and reconstruction—having in view the present and near prospective congestion of its location and the range of occupancy proposed—should fully include in design, specifications, construction and appliances adequate safeguards against danger to life and property. All buildings should be required by law to be fitted with adequate fire exits and escapes proportioned to their human occupancy in accord with reasonable exit tests. Outside fire escapes are deemed the least desirable of all forms.

Topic No. 4—"Building Codes."

Note—The aggregate of unit building construction problems becomes the like community problem, or the Building Code (state or local).

Resolution—It is the sense of the convention that:

(a) All building construction and reconstruction should be under government control, state or local, to the end that the greatest safety for the greatest number for the present and future should be assured;

(b) Each of the several states should adopt a state building code with requirements which local governing bodies may raise but not lower by local enactment, said requirements to be enforced by proper governmental machinery.

(c) The classification of building construction is entirely one of relative ability to resist attacks by fire, and therefore in all building codes the term "fireproof" should be replaced by "fire-resistant," and ordinary frame construction should be classed as "combustible";

(d) The National Fire Protection Association is hereby requested to recommend approved standards of fire-resistant construction which may be used by states and municipalities in their respective building codes.

[Section (d) was subsequently modified in its force and intent by resolution adopted under Topic No. 8, "Compulsory Physical Standards," whereby the recommendations of the National Fire Prevention Association and other originators of standards are to refer same for approval to the Bureau of Standards of the Department of Commerce of the National Government at Washington.]

Topic No. 5—"Protection (Private)."

Note—The best located and constructed unit building is now held to need protection (usually water supply and/or chemicals) to reasonably assure safety against fire for the building itself as well as for its contents in life and property—hence this consideration comes next in order after the actual construction (often with it).

Resolution—It is the sense of the convention that:

(a) Every building—for its own safety and that of its contents in life and property—should be fitted reasonably, with respect to its location, character and use, with proper mechanical aids to discover, alarm and extinguishing fires and to resist lightning; and

(b) The occupants of every building should be reasonably educated regarding the physical structure thereof, and how to leave same in a quick and orderly manner, and be organized reasonably to fight fire therein.

Topic No. 6—"Protection (Public)."

Note—Communal fire protection is essential in addition to all like private unit agencies—hence this topic in this place.

Resolution—It is the sense of the convention that:

(a) All communities need physically a sure water supply, broadly usable by citizens for private fire protection, under the least onerous terms—also adequate fire-fighting apparatus with proper personnel to operate same; also an adequate alarm system—all proportionate to the character, area and population of each community; and

(b) All fire-fighting forces should be efficiently organized in enduring form, under legal control and disciplined when possible—their morale and requirements should be high and solely influenced by good service considerations; and the training should be constant and adequate for efficient fire-fighting and fire-prevention inspection and the purchase and maintenance of the valuable special mechanical apparatus.

Topic No. 7—"Equipment."

Note—It is necessary to heat, light, ventilate and otherwise "equip" every unit building wherever located; and this equipment is all productive, and/or receptive, of fire hazard—hence its appropriate consideration at this point.

Resolution—It is the sense of the convention that:

All equipment for buildings should be adequately designed and constructed with respect to its fire hazard—productive or receptive—and that its use should be predicated on reasonable compliance with such requirements, and should be reasonably regulated everywhere by law.

Topic No. 8—"Compulsory Physical Standards."

Note—If the thought is sound that reasonable enforced laws are necessary to control the purely physical problems of so constructing, protecting and equipping buildings as to abate fire waste, then it becomes of maximum importance to define uniformly and precisely the not unduly burdensome technical physical things required in such laws by the best experience—hence this consideration at this point.

Resolution—It is the sense of the convention that:

In view of the growth of state laws and municipal ordinances to prevent the appalling loss of life due to fire and to control fire waste by the widespread legal imposition of physical requirements upon construction, protection and equipment of buildings, it is now important that:

(a) Physical standards on this entire subject be formulated which may be generally and legally imposed without undue hardship or cost upon the public; and

(b) That the federal government through its Bureau of Standards of the Department of Commerce should arrange to review such standards for approval and promulgation in uniform language, to the end that they may be used by states and municipalities in laws and ordinances; and therefore be it further

Resolved:

(c) That the National Fire Protection Association be requested through its Executive Committee to arrange for a conference of delegates, with the chairman of this convention as chairman; from the American Society for Testing Materials, the American Society of Mechanical Engineers, the American Society of Civil Engineers, the American Institute of Electrical Engineers, and all kindred national societies having standards bearing on this subject, for the purpose of collecting such standards for submission to the federal government; and be it further

Resolved:

(d) That the conference thus formed be requested to take the necessary steps to bring these resolutions before Congress and to secure the required legislation at the earliest opportunity.

Topic No. 9—"Occupancy" and Topic No. 10—"Annual Occupancy."

Note—Every use or "occupancy" of any building contains in itself an inherent fire hazard to that structure and its contents in life and property, and also to its environing community; hence consideration here of this danger in completed buildings.

Resolution—It is the sense of the convention that:

(a) The individual occupancy hazard (the relative fire hazard to life and property in any given building inherent in any given pursuit) should be definitely controlled as to construction by the building code; and as to management by proper police (or equivalent) continuous regulation to assure reasonable safety of life and property therein;

(b) The general occupancy hazard (the relative community hazard inherent in any given pursuit) should be definitely controlled in every populous community by law, which should exclude extra hazardous pursuits, and properly place and safeguard by appropriate rules permissible hazardous pursuits in their appropriate danger zone (or other like delimited area); and

(c) The control of occupancy conditions, through requirements imposed by law, is essential for the abatement of fire waste of life and property; and this control to be actual and effective should cover all property (at least in cities) and continuously—at least once annually—and upon every substantial change of tenancy, through the agency of an occupancy license based upon competent legal inspection by the fire-fighting force or an adequate similar agency.

Topic No. 11—"Management."

Note—The preceding topics all dealt almost exclusively with physical means to control and prevent fire waste. This topic considers the moral as well as physical subject of cleanly and orderly daily living in property and its beneficial influence in abating and controlling fire waste.

Resolution—It is the sense of the convention that:

Based on evidence and opinions obtainable approximately one-half of all fire waste—including avoidable fires without fraud as well as arson fires—arises from ignorant, shiftless, dirty and vicious use of property (which condition causes an approximate-like proportion of sickness and immorality in all populous centres) and therefore minimum continuing requirements as to clean and orderly living and the suppression of dangerous fire-breeding nuisances (such as the snap match, dangerous smoking, careless storage of rubbish, ashes, etc.) should be imposed by law in all communities, through the agency of the police power, acting through state and municipal fire marshal (or like officials), using the active fire-fighting organization for inspections as much as possible and all volunteer aid procurable.

Topic No. 12—"Legislation."

Note—This topic considers the need and scope of legislation to control fire waste.

Resolution—It is the sense of this convention that:

While fire loss of life and property is always local in inception, its result is national in effect, and hence its control must be effected by the operation of a sum total of state and municipal laws which will suppress the range of fire hazards to an attainable minimum everywhere and all the time; and that by this course alone can the sum total of fire waste of life and property be speedily and substantially reduced, and the cost of fire insurance (which reflects this total loss) be lessened throughout the country.

Topic No. 13—"Education."

Note—No programme can succeed unless understood by, and in sympathy with, the mass of people; hence consideration here of the problem of widely informing the nation about the physical phases of fire danger and waste and the imperative need of reasonable legal regulation on the subject.

Resolution—It is the sense of this convention that:

Education of the public about fire danger and waste of life and property should be provided in all laws, ordinances and regulations on the subject; and all interests concerned should not only join issue in collecting accurate and authoritative data, but make equal effort to disseminate this information regularly and continuously among all the people in readily understandable language, to the end that they may not only accept, but demand proper fire waste regulation and live in full accord therewith.

Topic No. 14—"Insurance."

Note—Despite all future effort and regulation some fire waste must continue, hence consideration here of insurance, or the distribution financially of this waste.

Resolution—It is the sense of this convention that:

(a) The several states, territories and provinces should not only assure that permissible fire insurance is stable financially, but that the form of contract should be as clear, brief, explicit and sound as possible and, as nearly as may be, uniform in substance in all these jurisdictions, to the end that all such policies permitted to issue throughout the country may equally and adequately protect all citizens, including the ignorant and inexperienced; and

(b) Said jurisdictions should as nearly as possible adopt uniform regulations governing:

1. Issuance of fire policies on property.
2. Licensing of fire insurance agents and brokers, and
3. Licensing of fire insurance adjusters:

To the end that only reasonable insurance contracts will be permitted on property, and that only men of sound character will be admitted to the business of writing fire insurance and adjusting fire losses, thus discouraging arson and complicity with fraudulent losses.

A large amount of re-construction is being carried out by the Montreal Tramways Company. The track in various parts of the city are being relaid, and new intersections of 132 lb. rails put in. This is in accordance with the programme of improvements outlined by Mr. W. F. Graves, the chief engineer.

Patents and the War

By Stanley Lightfoot, Registered Patent Attorney, Lumsden Building, Toronto.

IN order to meet the need of manufacturers and inventors for information concerning their actual position in view of existing circumstances, a general review of the patent situation both here and in Great Britain is given, dispensing with technicalities which would only be misleading to anyone not well acquainted with the patent law.

In the first place the provisions which have been made in both Canada and Great Britain are almost identical, and in treating the requirements and provisions of the new order which has been passed under the War Measure Act, 1914, in this country, it may be taken for granted that the same applies on the other side of the water, excepting where otherwise referred to.

Patentees or applicants for patents who have volunteered for active service, or who for other reasons arising from the state of war, are unable to file such documents or do such other acts as are required by the Patent Office within a certain time, may be granted extension of time for the filing of such documents, the duration of such extension being governed by the particular conditions of the case. The extension may also be granted when it is shown that the documents could have been filed, but under the circumstances arising from the state of war this would be prejudicial to the rights or interests of the applicant or patentee.

It appears to be the general opinion that the annulment of patents held by or giving benefit to persons who are subjects of a state at war with His Majesty comes automatically into force and that every patent so held is now void. This is not so and only takes place upon request being made to the Commissioner by some person who intends to manufacture the patented article, or otherwise commercially promote the same in a manner calculated to be in the interests of commerce, either throughout the Dominion or locally. The Commissioner may annul a patent under the terms of this Act at his own discretion, however, without request if he deems it advisable.

Applicants for the voidance of a patent under this Act should present at the Patent Office, a petition, together with the prescribed fee of $10.00. The Commissioner will then, if he deems the application to warrant it, annul the patent, either totally or partially and retain the right to revoke such voidance or suspension at any time if necessary. Where the case demands, the Commissioner may require and impose certain terms and conditions.

Subjects of a state at war with His Majesty are also liable to have any of their proceedings on patent applications voided or suspended.

Provision is also made to prevent subjects of a state at war with His Majesty from making assignments of their patents for the purpose of avoiding the provisions of this Act and such assignments are liable to be declared invalid. Manufacturers purchasing German or Austrian patents, at the present time, should take particular note of this fact.

Several applications have already been registered by Canadian manufacturers for the annulment of patents under this Act and by taking full advantage of these provisions, the commercial activity of this country will be materially increased.

The British Patent Office has also made arrangements regarding documents intended for countries at war in which the lodging of patents may be difficult. These documents should be filed through the British Patent Office, when the Comptroller will date-stamp them and retain until such times as conditions would make it safe to forward to their destination by this means. Official evidence will be shown that the papers were fully executed and forwarded for filing on specified dates. Foreign renewal fees, etc., may also be paid in a like manner.

Personal Mention

Mr. F. N. Smith, Resident Engineer of Construction for the Canadian Northern Pacific Railway at Henningsville, B.C., has been elected a Member of the American Society of Civil Engineers.

Mr. A. F. Macallum, City Engineer of Hamilton, Ont., was elected First Vice-President of the American Society of Municipal Improvements at the annual convention of that body held recently in Boston.

Mr. D. R. Weber, Assistant Superintendent at Revelstoke, B.C., for the well-known Vancouver contracting firm of Messrs. Grant, Smith & Company & McDonnell, Limited, has been elected an Associate Member of the American Society of Civil Engineers

The New Chief Architect of the Department of Public Works

Mr. Edgar Lewis Horwood, A..R.C.A., F.R.A.I.C,. whose appointment to the position of Chief Architect of the Department of Public Works, at Ottawa, in succession to Mr. David Ewart, was recorded in our issue of October 7, was born in Monmouthshire, England, in 1868 and was educated at the St. John's College, Frome, and at the Prescott High School. He came to Canada in 1882 and studied architectural work in New York and Buffalo. He went into private practice at Ottawa in 1893 and continued until his appointment to the Federal position. Among the various important and attractive edifices at Ottawa which he has designed are the Carnegie Public Library, St. Luke's Hospital, Ottawa Collegiate Institute and Sun Life Building. From 1907 to 1909 he was President of the Ottawa Chapter of the Ontario Association of Architects. He is an Associate of the Royal Canadian Academy of Arts and a Fellow of the Royal Architectural Institute of Canada. He was gazetted a Captain in the 43rd Regiment, D.C.O.R., in April of this year.

Mr. E. L. Horwood.

Dr. Allan J. McLaughlin, Chief Sanitary Expert of the International Joint Commission, Washington, D.C., has been appointed City Health Commissioner of Massachusetts. It was Dr. McLaughlin, it will be recalled, who assumed charge of the sanitary survey work for the International Joint Commission which was created to study the pollution of the boundary waters between Canada and the United States and report upon methods of correcting such abuses as were found to exist, with special reference to the spread of typhoid fever. Among sanitary engineers the report of his survey of the Great Lakes, among other publications, is well known.

Mr. Frank W. Skinner, for many years Senior Associate Editor of the Engineering Record, is now associated in consulting practice with Mr. C. E. Fowler, of Seattle, Wash., specializing in bridge and structural steel work, foundations, and general civil engineering field construction methods. Mr. Skinner is established in new offices at 45 Broadway, New York City.

Mr. Alexander Potter, Consulting Engineer, New York City, whose name will be familiar to many of our readers as a contributor to this journal, presented a paper relating to the sewage treatment plant at Moorestown, N.J., at the Twenty-first Annual Convention of the American Society of Municipal Improvements held at Boston. An abstract of Mr. Potter's paper is given elsewhere in this issue.

Lt.-Col. Mitchell's Important Appointment

Mr. Chas. H. Mitchell, the well-known Toronto consulting engineer, who was formerly Intelligence Officer of the headquarters of the Second Division at Toronto, has been promoted to the rank of Lieut.-Col., and appointed General Staff Officer on the Headquarters Staff of the First Contingent. The appointment given to Lieut.-Col. Mitchell is one of the highest honors in the offering of the Canadian Militia.

Lt.-Col. C. H. Mitchell.

Mr. H. A. McLean, City Engineer of Sarnia, Ont., is terminating his engagement with the city at the end of this month.

Mr. A. Chausse, Building Inspector of Montreal, was a visitor at the annual meeting of the American Society for Municipal Improvements at which he read a paper on "Fire Prevention."

Mr. R. M. Milan, Saskatoon, has been appointed electrical superintendent of the Dominion Government interior storage elevator at Moose Jaw. Mr. Milan will have charge both of the installation and operation of the elevator.

Mr. Ralph Modjeski, of Chicago, has been retained as consulting engineer for the Second Narrows Bridge at Vancouver, B.C., filling the place made vacant by the retirement of Sir John Wolff-Barry. Messrs. Cleveland and Cameron, of Vancouver, are handling the matter locally as resident engineers.

Mr. Geo. Janin, Chief Municipal Engineer of the city of Montreal, has been busily engaged in organizing an engineering corps for active service in Europe. At the last word, Mr. Janin had received applications from some three hundred prospective recruits. Drills are already being held. It is of interest to note that sixty-five of Mr. Janin's applicants are of Belgian nationality. Of the total number of recruits, one hundred are employed by the Corporation of Montreal.

Mr. Jas. White, Assistant to the Chairman of the Commission of Conservation, Ottawa, advises us that the Commission has engaged the services of Mr. Thos. Adams, late Senior Town Planning Adviser to the Local Government Board of Great Britain. Mr. Adams is a recognized authority on his subject and is regarded as the foremost man in the profession in the Old Country. (Erratum.—In our issue of October 14 it was erroneously reported that Mr. Thos. Mawson had been engaged by the Commission).

Mr. George W. Coburn, district engineer of the Canadian Pacific Railway at Souris, Man., has been appointed district engineer at Brandon, Man. Mr. Coburn started work for the Canadian Pacific in 1896 as rodman and draughtsman at Franham, Que. From 1900 to 1902 he was engaged on construction work on various parts of the system, and in 1902 became assistant district engineer and draughtsman at Souris. He later served in similar capacity at Brandon and at Moose Jaw, Sask. Since 1907 he has been district engineer at Souris.

Mr. Chas. A. Tilden, for many years identified with civil engineering work in Canada, died recently in Chicago.

Mr. Harry B. Curtis, contractor, who had been in business at Medicine Hat for the last five years, succumbed recently from injuries received in an automobile accident.

St. John, N.B., Prosperous

FROM St. John, N.B., we are in receipt of encouraging reports concerning business and manufacturing conditions. Almost all the manufacturing concerns are running full time and some are working over time. Particularly is this the case in the woodworking industry. Messrs. Murray & Gregory, Limited, who employ 250 hands, are doing night work in some of their departments, while Messrs. Campbell Brothers, axe and edge tool makers, record an increased demand for high grade goods. One firm manufacturing boxes and box shooks, another firm of wholesale shoe dealers, and still another firm of bedding manufacturers, find much encouragement in the outlook. We mention these facts to show the manner in which business activity is distributed in the constructional field.

Announcement is made that the Intercolonial Railway has taken over the Valley Railway. This will mean additional railway projects at an early date.

In the building line, construction has commenced on the new tuberculosis hospital. On St. James Street a large Salvation army Shetler is to take the place of the Metropole which was destroyed by fire last year.

Recently the City Council invited the citizens to subscribe to a bond issue of $24,000 for public improvements. Within a short time nearly double the amount required was subscribed.

The Hamilton Board of Trade is strongly in favor of the construction of the proposed bridge which would cut away the Valley Inn hill when the Hamilton-Toronto concrete roadway is built. The sub-committee on good roads has obtained an estimate from the Hamilton Bridge Works on the cost of such a bridge, the figure obtained being $228,000 for a bridge 1,600 feet in length. Another plan for a bridge slightly over 1,000 feet long will be submitted to the bridge works shortly for an estimate. Mr. D. B. Wood is President of the Hamilton Board of Trade.

Mainly Constructional

East and West—From Coast to Coast

EASTERN CANADA

The Western Foundation Company of Canada, Limited, has been incorporated at Toronto with a capital of $200,000.

The Canadian Shipbuilding & Drydock Company, Limited, Owen Sound, Ont., has been incorporated with a capital of $2,000,000.

In answer to several enquiries, we may say that no appointment has yet been made to the vacant city engineership of Ottawa. Mr. F. C. Askwith is Acting City Engineer.

A new sewage disposal plant for the east end of the city of London, Ont., is under consideration. Plans have been prepared by Mr. Willis Chipman, consulting engineer, Toronto.

Plans are being prepared for a furniture factory which Mr. J. E. Baechler proposes to erect at Goderich, Ont,, at a cost of $50,000. The architect is Mr. J. Fowler, Goderich, Ont. Work has not yet started.

Foundation work is under way for a new school on Dundurn Street, Hamilton, estimated to cost $100,000. The building is to be two storeys high, of brick construction. Messrs. Stewart & Witton are the architects.

Mr. Norman McLeod, the contractor for the construction of the filtration system which the city of Montreal is installing at a cost of $1,000,000, has been granted an extension of one year for the completion of the work.

Foundation work has been completed for a six-storey reinforced concrete apartment house building which is to be erected on Bay Street South, Hamilton, at a cost of $100,000. The architects are Messrs. Stewart & Witton.

Operations are proceeding on the erection of the new St. Francis R. C. Church on Grace Street, Toronto. The building is of stone, steel and brick construction and is costing $100,000. The architect is Mr. A. W. Holmes, Toronto.

Exterior work on the addition to the University of Ottawa is nearing completion. The work upon completion will cost $150,000. Mr. C. P. Meredith, Ottawa, is the architect, and the contractors are Messrs. C. E. Deakin, Limited, of Montreal.

Lloyd, Blackmore & Company, Limited, have been appointed architects for the Smiths Falls Aluminum & Brass Foundry Company on a building which will cost in the neighborhood of $15,000. They expect to call for tenders in the near future.

The township of Barton (Hamilton) is contemplating the installation of a sewerage system. An outline of the scheme has been prepared by Mr. A. F. Macallum, City Engineer of Hamilton and Mr. A. Nicholson, Township Engineer of Barton.

At North Bay there is under construction a new building for the French Roman Catholic church. The basement only will be completed this season. The main building will probably be started next spring. The estimated cost of the church is $100,000.

At Montreal, the Board of Control has decided to carry on all public work possible in order to provide for the unemployed. It is stated that work in sight will provide labor for 10,000 men for six weeks from November 1st. The rate of wages will be $2.50 a day.

At a meeting of the Canadian Railway Club, Montreal, Mr. G. E. Smart, master car builder of the Intercolonial Railway Company, read a paper on "Wood Frame Cars in Freight Trains of Today." Mr. L. C. Ord, assistant master car builder of the C. P. R., presided.

Building operations are to commence shortly on the proposed public market at Maisonneuve, plans for which have been prepared by Mr. M. Dufresne, Montreal. The building, which is estimated to cost $100,000, will be 2½ storeys high, of brick, granite, and stone construction.

Of the new work in progress for the Canadian Vickers Limited, at Montreal, mention may be made of an engine and boiler house estimated to cost $165,000. The new plant is being erected according to the plans of Sir Wm. Arrol, of Glasgow, Scotland, and the general contractor is Mr. E. G. M. Cape, Montreal.

The new Customs House at Fort William, Ont., which is being erected for the Dominion Government by Contractor W. Braden at a cost of $175,000, is making good progress. The exterior work is now nearing completion. The building will be three storeys high, of reinforced concrete, stone and brick construction.

At Ottawa, steel work is in progress on the new church which is being erected on Fairmont and Wellington Streets by the Capuchin Fathers. The building, which is to be of stone construction, will cost $156,000. The architect is Mr. Chas. Brodeur, of Hull, Que., and the general contractors are Messrs. Noel & Monette, Ottawa.

The new chain factory at Niagara Falls, Ont., erected for the Dominion Chain Company according to plans prepared by Mr. E. D. Pitt, is nearing completion. The plant, which has cost $150,000, has been erected by Messrs. S. Austin & Sons, Cleveland. The building is two storeys high, of reinforced concrete construction.

Building operations have commenced on a new edifice at the corner of Lowther Avenue and St. George Street, Toronto, for the First Church of Christian Science. The estimated cost is $100,000. Mr. S. S. Beman, Chicago, is the architect, and the general contractors are the Sutherland Construction Company, Limited, Toronto.

At Sherbrooke and Montcalm Streets, Montreal, building operations are to start on a new library building estimated to cost $200,000. Detail plans are not completed and the contract is yet to be approved by the city council. Mr. E. Payette, of Montreal, is the architect, and the Foundation Company, Limited, have the contract for the foundations.

As previously reported in this journal, work is in progress at Toronto on a factory building, estimated to cost $1,250,000, for the Canadian Kodak Company, Limited, Toronto. The plant will consist of five reinforced concrete buildings. The general contractor is Mr. C. E. Deakin, Montreal, while the architect and engineer is Mr. C. K. Flint.

Charlottetown, P.E.I., reports plasterng work in progress on the new church which is being erected for St. Dunstan's R. C. Cathedral at a cost of $200,000. The new building, progress on which has been reported in these columns from time to time, is of steel, brick and stone construction. The general contractors are Messrs. J. S. Metcalf Company, Montreal.

At a meeting of the special committee appointed recently by the various municipalities interested in the project of constructing a permanent roadway from Toronto to Oshawa, it was decided to ask the provincial government to make a survey of the road and estimate the cost of a 16-ft. concrete roadway with gravel shoulders and a concrete base 7-in. thick. The estimated cost is $170,000.

Fraser, Brace & Company, the contractors for the hydro-electric plant of the Cedars Rapids Manufacturing and Power Company, have nearly finished their contract, and it is probable that the latter concern will begin supplying power early next year. The work of constructing the canal is finished, the power house is complete, and all the heavy machinery has been installed. The two transmission lines, one to Montreal and the other to Messena, N.Y., are well on their way to completion.

At Ford City, Ont., a new factory is being erected at a cost of $300,000 for the Ford Motor Company of Canada. The building is to be six storeys high, 200 ft. x 195 ft. in dimensions, of steel and reinforced concrete construction. The architects are Messrs. John Graham & Company, of Windsor, and the general contractors are Messrs. Wells & Gray, Toronto. The Canadian Bridge Company, of Walkerville, have the contract for the steel work.

WESTERN CANADA

Plans for the proposed grain elevator at Vancouver have been completed and it is understood that tenders for the erection of the building will be called shortly.

Tenders are to be invited shortly for a new 8-roomed school building at Point Grey, B.C. The building will be of reinforced concrete, stone and brick construction. The estimated cost is $50,000.

At a meeting of the Manitoba Branch of the Canadian Society of Civil Engineers held recently in Winnipeg, Mr. W. G. Chace gave an outline of the work done in connection with the Shoal Lake water scheme.

The new Provincial Parliament Buildings at Winnipeg, now in course of construction, are up two storeys. The dimensions of the building are 340 ft. x 320 ft. and the estimated cost is $2,000,000. The architect is Mr. F. W. Simon and the general contractors Messrs. Thos. Kelly & Sons, Winnipeg.

November 30th is the closing date for submitting competitive designs for the proposed Civic Centre at Vancouver. The authors of the designs placed first and second will be awarded premiums amounting to $500 and $250 respectively. The Secretary of the Vancouver Civic Centre Committee may be addressed at 543 Hastings Street West, Vancouver.

Sewage extensions at Vernon, B.C., involving an expenditure of $100,000, are about to be placed under construction. Messrs. DuCane, Dutcher & Company, Vancouver, have been appointed consulting engineers for the White Valley Irrigation System and are at present carrying out the proposed extensions. An outlay of $500,000 is involved in the whole project.

At a meeting of the provincial legislature held at Edmonton, Alta., the Premier introduced a resolution of particular interest to the north country. The resolution makes special provision for the building of the Central Canada line to Peace River Crossing, or thereabouts, and will, if assented to by the House, bring the navigation of that important river, with its rich tributary districts within easy travelling distance of Edmonton.

At Edmonton, while municipal engineering work has been somewhat curtailed since the outbreak of the war, the expenditures in the various departments have been fairly heavy this season. The following is a statement f work totalling in value $1,776,000, which has been actually carried out or put in hand:—boulevards, $31,298.59; grading, $4,511.92; concrete sidewalks, $83,641.20; paving, $211,329.38; plank sidewalks, $47,366.58; sewers, laterals, $402,494.43; sewers (trunks), $930,581.74; water mains, $64,355.81.

Field work on the Greater Winnipeg water scheme is progressing satisfactorily according to the latest progress report. The following details of general work are given:—Contract No. 6, completed telephone line, permanent construction, 49 miles; temporary construction, 42 miles, total, 91 miles. Contract No. 5, steel rails, 8,716 tons received to date of a total order of 9,350 tons. Contract No. 7, splice bars, 1,004,176 lbs. 100 per cent. complete. Railway construction, common excavation, 70 per cent. of the estimated quantity; track laying, 40 per cent. of the main line; ballast, 33 per cent. of probable requirements; train hauled filling, 20 per cent. of the estimated quantity; fencing, 41.7 miles. Contract No. 10, clearing right of way, 2,600,682 acres, contract completed. With regard to the Falcon River dyke, it was reported that the progress required was 60 per cent., and the progress made was 69 per cent., so that the contractors were well ahead with the work. Work has also commenced with ditching from Indian Bay to Snow Shoe Bay. Forty per cent. of station buildings have been completed, 20 per cent. of the superintendent's house, 90 per cent. of two cottages and 50 per cent. of a third, and 95 per cent. of the pumping house. There were 1,165 men engaged in the work, and 54 horses.

Constructional Activity at Regina

The action of the city of Regina in proceeding with the construction of improvement works has had a reassuring effect upon constructional activities in general. Several large buildings are now in course of construction, and others will be commenced in the near future. Among the new buildings proposed is one for the Regina I. O. F. Lodges; another is a church building for the Wesley Methodist congregation, and another is a Labor Temple for the trades unions.

The Saskatchewan Co-operative Elevator Company, with headquarters at Regina, are having their new office building rushed through to completion as quickly as possible. This building is 125 ft. by 100 ft. in dimensions.

The city of Regina has decided to rush through to completion the construction of a 5,000,000 gallon reservoir. At the present time about sixty-five carpenters and eighty laborers are employed on the work. At the base, the concrete walls are 2 ft. 9 in. thick, tapering to 1 ft. at the junction with the roof. This wall is to be reinforced with a brick veneer 1 ft. in thickness above ground level.

The new Regina power-house is rapidly nearing completion. If the work progresses as rapidly in the future as in the past the building will be completed within a month. The cost will be approximately $170,000. The cost above ground was $90,000, in addition to $36,000 for steel. The foundation and ground floor were constructed by the city by day labor at a cost of $40,000. Up to the present, nearly $100,000 worth of machinery has been installed.

From the Link-Belt Company, Chicago, we have received a copy of the 1914 edition of their book, No. 124, entitled "Steel Chains." The firm's products are described and illustrated very clearly. Details as to size and construction are given in tabular form. The chains are listed in the order of strengths and a numerical index facilitates reference.

From Mr. Stanley Lightfoot, Registered Patent Solicitor and Attorney, Toronto, Ont., and Washington, D.C., we have received an informative booklet dealing with patents, designs and trade-marks. The various ways in which industrial protection is obtained are explained fully and the information offered will repay the careful study of inventors and manufacturers.

The Pedlar People, Limited, of Oshawa, have been awarded a large contract for metal flume by the White Valley Irrigation & Power Company of British Columbia. The material is to be used in the completion of the Grey Canal, and the order—which is one of the heaviest for this kind of piping ever placed in British Columbia—calls for 9,000 feet, varying in diameter from 61-in. to 30-in. The contract was placed with Mr. R F. Mather, of Mather, Yuill & Company, British Columbia, representatives for the Pedlar People.

Contracts Department

News of Special Interest to Contractors, Engineers, Manufacturers and Dealers in Building Supplies

Waterworks, Sewerage and Roadways

Barton Twp., Ont. (Hamilton)
Reports estimating the total cost of installing a sewerage system on the mountain in the Township of Barton; also in the east end have been submitted by Mr. J. B. Nicholson, Twp. Engineer. The estimated cost of the former is $357,863 and of the latter $161,664.

Berlin, Ont.
The City Council will construct storm sewers on John Street, providing the necessary funds can be raised. Mr. Herbert Johnston is the engineer.

Brantford, Ont.
A committee of the City Council have requested permission of the Provincial Government to proceed at once with work on Boulevard Drive, estimated cost of which is $27,000. Mr. T. H. Jones is the engineer.

Halifax, N.S.
Tenders will be received by Mr. E. H. Armstrong, Halifax, Commissioner of Provincial Government Department Public Works, until noon, November 2nd, for construction of 107 culverts in Shelbourne Count on road around Cape Sable, approximately 17.57 miles long. Plans and specification are at offices of postmasters, Clark's Harbor, Shelbourne and Barrington, and at the Department, Halifax.

Hamilton, Ont.
Work is under way on construction of sewers, the contract for supplying piping at $16,000 having been obtained by McAllister & Company, Standard Bank Bldg., Toronto.

Hawkesbury, Ont.
The Municipality of West Hawkesbury has in contemplation the construction of a crushed stone road estimated to cost $2,000. Mr. F. Stidwell, Cornwall, is the Engineer.

Kingston, Ont.
A deputation representing all municipalities between Toronto and Oshawa, with the exception of Toronto, waited on members of the Provincial Government recently to request the appointment of an engineer to make a survey of the cost of a 16-ft. concrete roadway with gravel shoulder, 4 ft. in width, and of estimated division of cost of this and a macadamized road over the same area. The Government granted the request for an engineer's survey.

London, Ont.
The erection of a municipal Sewage Disposal Plant for the east end of the city is contemplated by the City Council. A site for the plant is at present being selected.

Ottawa, Ont.
The City Council has in contemplation the construction of a 12-in. water main on Bank Street at an estimated outlay of $12,000.

The City Council is inviting tenders for the construction of asphalt pavement on Booth Street between Somerset and Queen Streets, estimated to involve an outlay of $32,500. The following are the approximate quantities:—asphalt, 9,440 sq. yards, water table 2,650 sq. yards, gutter 4,500 lin. feet, headers 350 lin. ft. Mr. F. C. Askwith is the City Engineer.

Work is to start by day labor on pavement work on Bank Street at an estimated outlay of $96,000. Mr. F. C. Askwith is the engineer.

The City Council is about to carry out rock grading between Carling and Earnest Streets at an estimated outlay of $3,000. Work will be carried out by day labor. Steam drills and rock equipment are required. Mr. F. C. Askwith is the Engineer.

Stratford, Ont.
The Board of Works has approved all plans for construction of sewers and culverts. Tenders will be called next spring. Mr. A. B. Manson, City Hall, is the Engineer. Mr. J. A. Gray, Secretary.

A by-law authorizing the construction of a Crushed Stone and Macadamized roadway on Ontario Street, from Queen Street to City Limits, has been carried. Mr. A. B. Manson, City Hall, is the engineer.

St. Marys, Ont.
The Town Council has decided to expend about $1,900 on cement curbs and gutters for four blocks. Mr. Thos. M. Clarke, Town Clerk.

Toronto, Ont.
Tenders will be called shortly for the laying of about 1,000 ft. of 72-in. steel conduit from reservoir to filtration plant, Toronto Island. Mr. R. C. Harris, City Hall, is the Commissioner of Works.

Vankleek Hill, Ont.
The construction of gravel road by day labor at an estimated cost of $1,000, is contemplated by the municipality. Mr. W. H. Magwood, Cornwall, is the engineer.

Vancouver, B.C.
A recommendation has been made that the City Council proceed with the construction of sewers on six streets. It is reported that the work, which is estimated to cost $25,000, will be carried through by day labor. The Engineer is Mr. F. L. Fellowes.

CONTRACTS AWARDED

Hull, Que.
The contract for construction of cast iron water main extension on several streets has been awarded to Gendron & Wilson. The engineer in charge of the work is Mr. J. A. Laforest.

Toronto, Ont.
The contract for laying sidewalks on Dundas Street has been awarded to the Grant Contracting Company, Toronto, at $690, and to Godson Contracting Company, Manning Chambers, at $2,531 for pavement on Heath Street.

Winnipeg, Man.
Mr. J. W. Astley, Engineer of Construction, has been given the contract for construction of plank sidewalks on Mulvey, Bannerman and Higgins Avenues and Academy Road, at $1,772. Board of Control will invite tenders shortly for construction of granolithic sidewalks on Derby Street (2 sides), Spence, Austin and Helen Streets, at an estimated cost of $5,263.

The contract for construction of plank sidewalks on Machray Avenue, Charles Street, Oak Street, Sherburn Street, Warson Avenue E., and McMillan Avenue has been handed over by the Board of Control to Mr. J. W. Astley, Engineer of Construction.

The following contracts for paving work have been awarded by the Board of Control:—6 granolithic sidewalks on Canora Street, $157.50; asphalt No. 2 pavement, 24-in. wide, on Oxford Street, (approximately 680 ft.) $4,499.55; Ruby Street, $4,284.50 and Banning Street, $17,627.30. Mr. J. W. Astley, Engineer of Construction, is the general contractor. Mr. W. P. Brereton is the engineer.

Railroads, Bridges and Wharves

Brantford, Ont.
The Lake Erie & Northern Railway has been authorized by the Railway Commissioners to construct a bridge across the Grand River in this district.

Glenmorris, Ont.
The Railway Commissioners have given their approval to the location of a station for the Lake Erie & Northern Railway.

Luxon, B.C.
The Canadian Pacific Railway is erecting a station at this point 54.3 miles south of Golden on Kootenay Central Lines. The location has been approved by the Railway Commissioners.

North Vancouver, B.C.
The Pacific Great Eastern Railway, Vancouver, has had plans drawn for two stations to be erected on Fell and Pemberton Avenues. Tenders for the work will not be called for some time.

Province of Alberta
The G. T. P. Branch Lines Company is constructing a spur for Todfield Clay Products Company.

The C. N. R. is constructing a spur to the property of Pembina Coal Company, Limited, a spur to Worswick Paving Company, Limited, Edmonton, and to the location of the Slocum Coal Properties.

The C. P. R. will construct additions and alterations to spurs from Western Canada Flour Mills Company, Calgary; a spur and branch for the Maple Leaf Milling Company, Medicine Hat; a spur for Hewitt & Black, Limited, Medicine Hat, and also for McDonald Construction Company, Limited, Calgary.

Province of British Columbia
The Canadian Pacific Railway will construct a spur for the accommodation of the Ross-Saskatoon Lumber Company,

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Alphabetical Index of Advertisers
Page 18

Vol. 28 **November 4, 1914** **No. 44**

Principal Contents

Page
Side-tracking Canadian Contractors 1337
Ottawa's "Waterworks Muddle" 1338
Pro Patria 1338
A Discussion of the Process of Pumping Wells By Compressed Air 1339-42
By O. W. Smith, A. M., Can. Soc. C. E.
Cement Gun Construction at the Hospital for the Insane, Whitby, Ont. 1343-5
By H. B. Magowan
Design and Construction of the New C. P. R. Hotel at St. Andrews, N. B. 1346-7
System of Unit Concrete Construction as Applied to the Power Buildings at Cedars, Que. 1348-51
By John E. Conzelman
Features of the Principal Types of American Wharf Design 1352-3
Uniformity in Compiling and Reporting Statistics of Water Purification Plants 1354-5
Paving Floors Like City Streets 1356
Specification for Sand in Reinforced Concrete 1356
Data Relating to Wear and Cost of Concrete Roads with Details of Maintenance Expense 1357-8
By W. S. Shaw
Remodelling a Septic Tank and Contact Filter Sewage Plant 1358
By Alexander Potter, New York
The Effect of Leaking Illuminating Gas on Bituminous Pavements 1359
By George C. Warren
Slag Macadam for Road Paving 1360-1
Constructional News 1362-3
Personal Mention 1363-4

Side-Tracking Canadian Contractors

WITH the constructional activity of the season drawing to a close the City of Hamilton is setting an excellent example and showing considerable foresight in engaging upon the construction of a new hotel, the Royal Connaught, estimated to cost $1,000,000. There has been considerable discussion about this project and in certain quarters unfavorable comment upon the award of the contract to a Bostom firm has been made. All are agreed that large constructional schemes of this kind are productive of good effect, not only in providing employment, but in re-assuring people generally by showing them the confidence possessed by a few at least of those who are able to finance million-dollar undertakings. It is contended by some, however, that the principles governing the publicity which has helped to finance this project and the spirit which has animated the award of the contract to a United States firm are inconsistent; further that the employment of Canadians can be guaranteed only by giving contracts to Canadian principals. It is only fair to say that this view is entirely a misconception arising out of an imperfect knowledge of the facts. Upon enquiry we learn that the Boston firm's success in obtaining this contract was due to the fact that they were able to negotiate a considerable block of the hotel company's bonds, representing an investment of some three-quarters of a million dollars. Moreover, the company is an authorized Canadian firm, having a Canadian charter. A condition to which this outside firm agreed was the letting of all sub-contracts to Canadian contractors and the purchasing of all material possible in Canada. It is fair to assume that they will live up to the undertaking.

Certain contractors of our acquaintance seize with avidity upon such cases as these and demand to know whether, if the conditions were reversed, Canadian contractors could look for any business in the States. Here is a case where such argument is unjust and not in the best interests of the country.

Canada is reaching out in all directions for new trade and we must admit of no sentiment calculated to hamper intercourse with the United States. It is "the strong pull, the steady pull, and the pull altogether, boys," which sets things in motion. We need all the co-operation we can get at the present time, and much more can be accomplished by mutual than by detached effort. If U. S. finance has sufficient faith in Canada to invest good money in Canadian undertakings at a time like the present, when conditions are depressed, at the same time undertaking to employ Canadian materials and Canadian workmen, by all means encourage them. Let it be remembered that we have not yet reached the stage of independence. We have unlimited opportunities for development, but to prosecute that development we are dependent entirely upon foreign capital. Even the cry of Canadian-made goods is in reality a very distant call, for we have not yet arrived at the point where our manufacturing facilities are anything like equal to the demands of the country's development.

The President of the Hotel Company is Sir John Gibson, formerly Lieutenant-Governor of the Province of Ontario. Doubtless the award of this contract received his personal approbation. The appearance of his name among the directorate of the company reinforces our argument in favor of placing a generous construction upon the policy of bringing in outside capital through contract channels.

Ottawa's "Waterworks Muddle"

WITH its "off agin, on agin" policy of approving and disapproving plans for a new water supply, the city of Ottawa stands forth as the "Finnegan" of the waterworks field, comments Engineering Record editorially. When, after years of controversy, the plan of treating Ottawa River water by mechanical filtration was approved recently by popular vote, it was thought that the last obstacle in the way of actual construction had been removed, but this assumption was premature, for the Provincial Board of Health, as already announced in the Engineering Record, has refused to approve the plans and specifications prepared by Hazen & Whipple, of New York, and indorsed by George W. Fuller and J. Waldo Smith.

This news is discouraging enough, but it is nothing short of startling when its bearing on legislation passed last winter is considered. That legislation provided that, in the event of the disapproval of the Ottawa River plan by the Provincial Board of Health, the city of Ottawa would be compelled to construct the necessary works for the Thirty-One-Mile Lake project, the Provincial Board of Health was empowered to proceed with all construction, assuming for the purpose all of the powers of the city of Ottawa. By the terms of the act the city is prohibited from appealing to the courts for an injuncion to stop the Provincial board in its effort to construct the Thirty-One-Mile Lake supply. The audacity of this mandate is apparent when it is realized that an excellent filtered supply of 35,000,000 gals. daily can be obtained from the Ottawa River for a cost of $2,000,000, while the Thirty-One-Mile Lake scheme, providing for a daily supply of only 25,000,000 gals., will run to $8,000,000. The constitutionality of such an act is open to question and the city undoubtedly will use every means in its power to combat it before submitting to what amounts to an extortion of about $6,000,000.

It is highly instructive to examine into the reasons of the Provincial board's disapproval of the Ottawa River project. They are, in their essence, that the Ottawa River is polluted and that provision is made in the plans for the use of hypochlorite of lime as an after-treatment, if this should prove necessary. As to pollution, the Ottawa River, in its raw state, contains generally something like 200 bacteria per cubic centimeter, and is comparable from the sanitary standpoint, according to the word of George W. Fuller, to Croton Water, which the people of New York drink unfiltered. It must be remembered, however, that the proposal was not to use Ottawa River water in its raw state, but to raise it to a high degree of purity by mechanical filtration. With respect to the use of hypochlorite, the board has distorted Allen Hazen's words, making it appear that the chlorinating treatment is one of the vital elements of the plan, instead of merely a precautionary measure. Mr. Hazen has since stated specifically that a good water can be produced without sterilization. The most ludicrous part of the whole affair is that the Provincial board, two years ago, approved practically the same plan for filtered Ottawa River water that it now feels called upon to reject.

From the whole complicated situation a clear moral can be drawn. As long as boards with no engineering representatives are vested with the power of passing upon the technical details of engineering works just so long will there be trouble. It is stated on good authority that when the plans for the Ottawa River filters were being explained to the members of the board, one of the questions asked was "Is there any sand in these filters?" Little more need be said.

Pro Patria

PROFESSOR C. H. McLeod, Secretary of the Canadian Society of Civil Engineers, acceding to a request made by this journal, has compiled a list of members of the Society who have gone on active service. The names follow in alphabetical order, accompanied by such particulars as to regiment and rank as are available:—

Adams, A. D.; Allen, L. E.; Anderson, T. V., as Major; Armstrong, C. J., as Lt.-Col.; Armstrong, J. D.

Ball, J. C.; Beullac, M. C. J., with the French Army; Bell-Irving, D. P., as Lieutenant with Engineering Corps; Blue, W. E.

Cameron, J. A.; Cardillac, G. de; Charton, P., with the French Army; Clarke, C. P.; Collins, W. S.; Cosgrove, J. R., as Lieutenant; Creighton, F. A.

Daniel, W. T., as Lieutenant; Dawson, S. G., with the Royal Canadian Engineers; Donaldson, J. M.; Donnelly, C., as Lt.-Col.; Downie, R. W.; Drummond, L., as Lieutenant with the Field Engineers; Duguid, A. F.; Dupont, George.

Eaton, H. T.; Erskine, J. A.; Everall, Wm. M.

Fowlds, E. S.

Goldie, E. C.; Greenwood, H. S., as Colonel.

Harcourt, R. H.; Harcon, J. F., as Gunner in Fifth Field Battery, 2nd Brigade; Helliwell, J. G., with 21st Regiment, Essex Fusiliers; Herdt, L. A.; Hertzberg, C. S. L.; Hertzberg, H. F. H., as Lieutenant with 2nd Field Company, Canadian Engineers; Hesketh, J. A.; Hewson, J. H.; Hick, H. C., as Trooper in King Edward's Horse; Hodgkins, F. O., as Captain; Hughes, G. B.; Hughes, H. T.

Irving, T. C., Jr., as Captain with 2nd Field Company, Canadian Engineers.

Lamb, H. J.; Leckie, R. G. E., as Colonel with 72nd Highlanders; Lestang, P. L. G. de, with the French Army.

Macdonald, Campbell; MacPhail, J. A., as Major; McCuaig, G. E.; McDonald, H. F.; McEwen, A. B.; McFarlane, M. L. D.; McNaughton, A. G. L.; Merrylees, L. F.; Middleton, J. R.; Mieville, A. L.; Mitchell, C. H., as Lt.-Col. and general headquarters staff officer; Morrissey, T. S.; Mullon, L. G., with the French Army; Mulock, R. H., with 13th Field Battery.

Nolan, A., as Lieutenant.

Oborn, S. M.; Oxley, A. C., 2nd Field Company, Canadian Engineers.

Patterson, A. L., with 5th Battery, 2nd Brigade Canadian Field Artillery; Perry, R. M.; Peters, H. P.; Pinget, R. C. L.; Power, A. L.; Pym, J. S., as Corporal Signaller, "A" Squadron, Royal Canadian Dragoons.

Rankin, F. S.; Redman, W. B.; Revell, G. E.; Rime, L. M. H., with the French Army; Ross, C. F. D.; Rosher, J. H.; Rutherford, F. S.

Scott, M. A., as Lieutenant, Auto Machine Gun Battery; Shaw, J. B.; Smith, D. A., with Corps of Guides; Spears, D. C., with No. 5 Company, Canadian Engineers; Stavert, W. D., as Lieutenant with 7th Field Company, Royal Engineers; Stewart, J. C.; Stirling, R. A.; Storms, D. H., as Lieutenant with 8th Battery, 3rd Artillery.

Tate, V. H.; Tingley, F. H., as Lieutenant; Turner, G. R., with No. 4 Provisional Company, Canadian Engineers.

Urie, H. R., with 2nd Field Company, Canadian Engineers.

Valter, R. de. 4

Watson, M. B.; Wilkin, F. A.; Wilson, J. A. G.; Worthington, A. N., as Lieutenant with 10th Royal Grenadiers.

A Discussion of the Process of Pumping Wells by Compressed Air

By D. W. Smith, A.M., Can. Soc C.E.

THE air lift as a pumping device was probably first used, we are told, at least experimentally, as early as 1797. Patents of the contrivance have been taken out from time to time in America, but not until late years has it been brought into practical use. Little accurate scientific knowledge was obtained regarding the method up to a few years ago. Investigators during the past few years have taken the matter up, and acquired many valuable facts regarding it, but as the most thorough of the tests have been made by companies, having patents on the market, or manufacturers of air machines, their conclusions and deductions have not become widely known by the engineering profession.

The theory of the operation of the air lift has been fruitful of much discussion, and the principle of its working has been variously stated. The principle of its action is generally conceded to be due to the lessened specific gravity of the water, in which the air is contained in considerable quantities, or through which it is rising in bubbles.

The following is a description of its action from tests made by the Westinghouse Air Brake Company. As the compressed air enters the discharge pipe, slightly above the pressure corresponding to the hydrostatic head, the column of water is forced upward. Air continues to enter, filling up the space left by the rising body of water, until the top of the water column reaches the discharge opening (Fig. 1). The moment that a portion of the rising water is discharged, the weight of the column is thereby reduced and the air below will correspondingly expand, reducing the pressure on the water at the base of the discharge pipe below the air inlet. The weight of the water outside the eduction pipe then forces the water up into the discharge pipe stopping for a moment the inflow of air.

The pressure of the air is quickly reinstated from the supply, so that it again forces an entrance into the discharge pipe. This is repeated until the whole eduction pipe is filled with alternate bodies of water and air rising to the discharge, the combined weight of which is enough less than the water in the well outside the discharge pipe to keep up a continuous flow from the free opening. As each body of air rises, the total weight of water above it grows less, and it consequently expands, until it reaches the surface where it discharges at atmospheric pressure. In this way a continuous flow of water is maintained from the well, as long as a sufficient quantity of air is supplied, and the capacity of the well is not overtaxed. Several methods of applying the air have been used as illustrated by the accompanying views.

Methods No. 1 and 3 are the most commonly used. The well casing, if in good condition may also serve as the eduction pipe, provided proper ratios of air pipe and discharge pipe can be obtained. (Fig. 2.) It is maintained that one method is as efficient as the other, but some investigators claim that the first method is more efficient because in it the column of water is offered no impediment to its free discharge, the area of available section is greater, and the friction consequently less. It may here be noted, however, that method No. 3 is the most convenient for altering the air line to suit any change in the conditions of the well. Providing the eduction pipe is long enough, the air line may be altered to suit a variety of submergence ratios without lifting the discharge pipe.

Especial advantages have been claimed for various types of air nozzles for releasing the air at the bottom of the pipe. These have been of many forms, including a perforated head, or slotted pipe, a contracted nozzle turned upward or downward, etc. No reliable or accurate data relative to their advantages, if any, over the plain open pipe, are yet obtainable. At the present time probably the majority of applications are from the open pipe only. The size of the air pipe depends upon the quantity of air required, its pressure, and velocity. These in turn depend upon the quantity of water to be raised and the amount of lift, and distance of well from compressor.

The drop in air pressure resulting from friction should be kept as small as possible to insure economical operation. The air piping should be so proportioned as to have not more than five per cent. frictional loss. The size of the eduction or discharge pipe will of course vary with the quantity of water to be delivered. The friction in the pipe of maximum discharge should not consume more than a few feet of head, and the velocity of the water ordinarily should not be over four feet per second.

The following table is submitted as approximating to the proper sizes of air and discharge pipes, corresponding to various charges.

Table 1.

Discharge gals. per min.	Size of Discharge pipe.	Size of Air pipe.
135	3½ inches	1¼ inches
180	4 inches	1½ inches
280	5 inches	2 inches
460	6 inches	2 inches

The depth to which the air pipe is submerged and the consequent pressure of the air required has an important bearing upon the efficiency. The result of tests which have been made show that the quantity of air used per gallon decreases with the depth until a minimum is reached, when it begins to increase. This point of minimum air consumption is the proper submergence, and is usually taken from 55 to 65 per cent. of the total length of air and water column. The submergence is usually expressed, as the ratio of the portion of air pipe submerged to total height of the air and water columns, measured from the point of its application to its free discharge into the atmosphere.

Air Consumption

The formula commonly used to determine the various factors of the air lift problem, is stated thus in Turneaures and Russill's Public Water Supplies:—

$$Q = \frac{125\ A}{H}$$

In which Q = gallons per minute.
A = cubic feet of free air per minute.
H = Amount of lift in feet.

Having given the quantity of water and the lift,

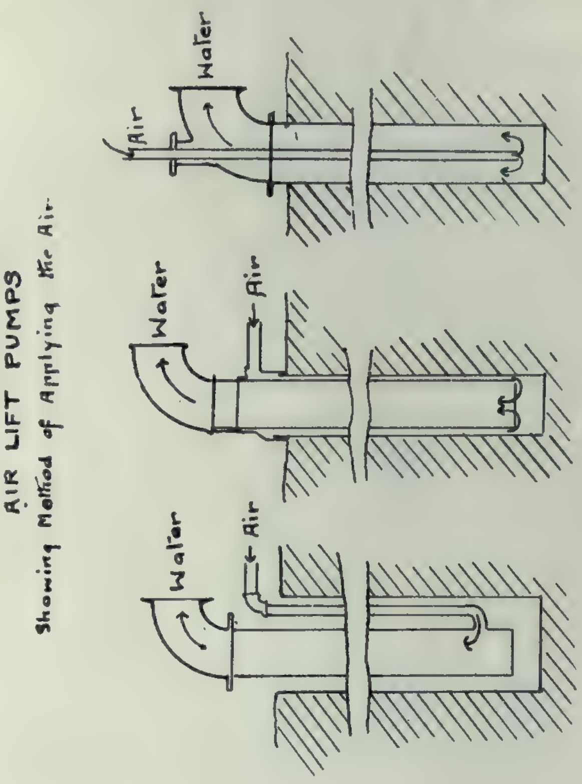
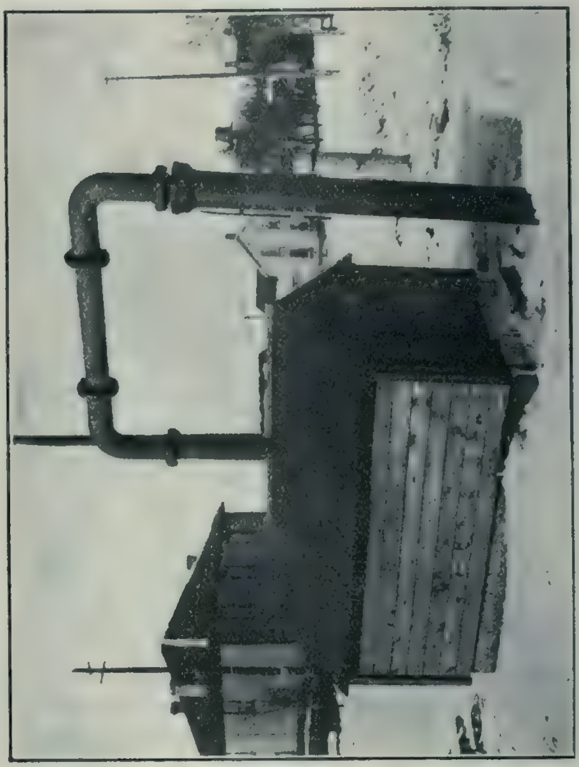


Fig. 2.



Discharge piping of well No. 3.

A Discussion of the Process of Pumping Wells by Compressed Air

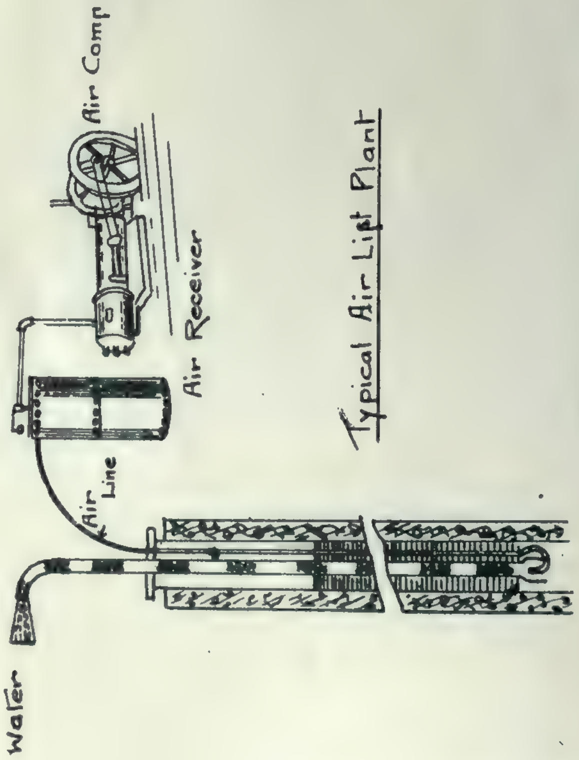


Fig. 1.

Well testing compressed air delivery, 200 ga's. per minute.

Pumping well No. 3 discharging 250 gallons per minute. Measuring weir in foreground.

the quantity of air required is found by transposing the equation to:

$$A = \frac{QH}{125}$$

Air Pressure

The air pressure required for pumping any depth of well will be slightly in excess of the pressure induced by the hydrostatic head, i.e., height of water column measured from the level of the water in the well to the point of air inlet. As the ratio of lift to submergence increases the air pressure decreases.

Application at Palmerston, Ont.

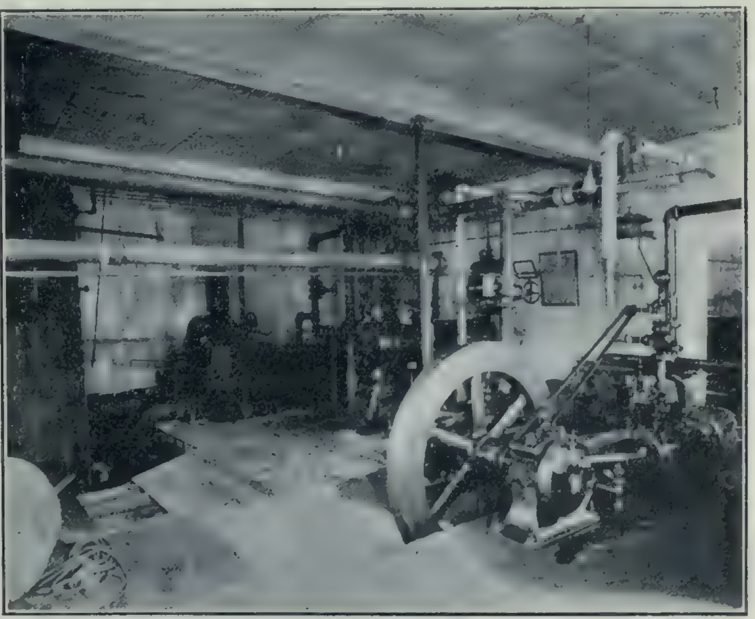
The compressed air method was applied to the civic wells in the town of Palmerston, Ont. A brief description of the wells and the accompanying natural conditions is as follows:

The water supply at Palmerston is taken from the underground limestone strata. This underground supply is tapped by two 8-inch wells, drilled to a depth of about 300 feet below the surface. Water is encountered at about 150 feet from the ground level and it rose to within 16 feet of the surface, before reaching its static level. Under a ten hour test with the air lift these wells each developed a discharge of 250 gallons per minute, the water level in that time dropped from 16 feet to 40 feet below the ground surface. For the last five feet this drop in water level was very slow and uniform, and when at the depth of 40 feet below ground the water level remained practically constant with a discharge of 250 gallons per minute from each well.

The wells were also tested singly and the water level was measured at regular periods during the time of pumping. This was for the purpose of ascertaining the effect of pumping of 250 gallons per minute would have on the body of underground water. The water level in the well, which was located over 200 feet away from the one which was being pumped, fell regularly during the operation, but maintained a level of 10 feet higher than the one in operation, showing that this was the head necessary to force the water being pumped through the sub-strata surrounding the well for a radius of 200 feet. From this, the advantage of locating the wells at some distance apart is evident.

Both wells are pumped by the air lift, and delivered into a concrete storage reservoir, 42 feet diameter and 10 feet deep, containing 100,000 gallons of water. Well No. 2, which is close to the side of the reservoir delivers directly into it. Well No. 3 discharges into the open end of an upturned 8-inch pipe and is gravitated back to the reservoir. As the horizontal discharge from the air lift should not be greater than 30 feet it was necessary to gravitate the water from well No. 3 to the storage reservoir. To provide the head necessary for this and to take care of the splashing which it was foreseen would occur, in the upright pipe, the height of the discharge of well No. 3 was made 5 ft. above the level of the overflow point of the reservoir. An 8-inch return main takes the water from this well and also serves as a supply pipe from the stand pipe to the concrete reservoir. By an arrangement of valves, the storage water in the stand pipe can be connected with that of concrete reservoir and both used for fire service when required. From the concrete reservoir the water is pumped into the distribution mains and standpipe by a compound duplex direct acting pump.

The air lift apparatus installed in the wells consists of a 5-inch eduction pipe placed inside of the 8-inch well casing, and screwed to a patent well head which is connected to the well casing by special flanges. The air line is 1½-inch pipe placed inside the eduction pipe, and is provided with a patented air nozzle, consisting of perforated brass cylinder, attached to the end of air pipe in the well. An air by-pass is taken off the main air line and keeps air pressure on the surface of the water between the discharge pipe and well casing. This is for the purpose of preventing the air surging up between the discharge piping and well casing. The air discharge or outlets were placed at the same level in both wells, and are each about 100 feet below the ground surface. As the water level in the wells is a varying quantity during periods of pumping, it was not possible to obtain a ratio of absolutely correct submergence for all conditions, but it was found



Pumping plant, showing compressor, pump and condenser.

that a 60 per cent. submergence figured for a water level of 38 feet below the surface gave satisfactory results in both wells. The compressor is a compound duplex machine with 12-in. horse-power steam cylinders, 16-inch horse-power steam cylinders and duplex air cylinders 12 inches diameter with strokes of 12 inches.

The compound duplex pump has high pressure steam cylinders 10-in. diameter low pressure steam 16 in. diameter duplex water plungers 12 inches diameter with stroke of 12-inch. Both machines run condensing, being supplied with a Burnham surface condenser, with combined air and circulating pumps. The surface condenser uses the water from the storage reservoir for cooling water, before it is pumped to the stand pipe. The compressor is supplied with an air receiver from which the air pipes are led to the wells. From this receiver, which is placed in the pumping station close to the compressor, a two-inch air pipe is laid to the most distant well, to reduce the friction loss in the pipe. The balance of the air piping is 1½-inch diameter.

Tests

Several tests of the operating efficiency of the pumping plant were made, and it was found that when both wells were discharging collectively 450 gallons per minute into the reservoir, under an average lift of 39 feet 0.38 cubic feet of free air per gallon was required. This is assuming the volumetric efficiency of the compressor to be 80 per cent. When the compressor was running condensing with 20 inches of vacuum, a duty of 16,000,000 foot lbs. per 1,000 lbs. of steam was developed for the pumping apparatus including the compressor. The air pressure in the air reservoir ranged from 31 lbs. at starting to 27½ at the end of a two hour's test.

In starting pumping operations air was admitted at first slowly into the wells, the valves on the air lines being only opened a small amount, allowing the air lines to gradually build up the pressure required. After a lapse of a few minutes the water comes with a great rush, after which pumping operations continue more uniformly. If insufficient air is admitted an intermittent flow will result; the valve should then be opened gradually, until the flow becomes continuous and this is the proper position in which to leave it. The cost of delivering the water depends in the first case on the efficiency of the air compressor, and it is important that the compressor should be carefully designed with properly proportioned valves, and air ports to keep the volumetric efficiency high, and the air as cool as possible.

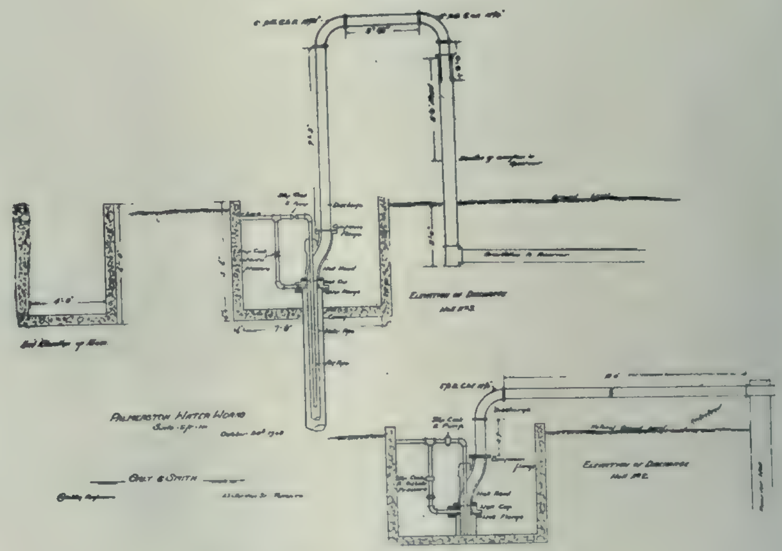
The next care is the proper proportioning of air and discharge pipes and the selection of the correct ratio of submergence of the pipe in the water to the total average lift. The most efficient scheme is the straight lift either to the surface or elevated tank, all long horizontal work being as far as possible avoided. In the air lift pump the ultimate efficiency is necessarily low on account of the many transformations of energy and its poor method of application. One of the principal losses is due to the slip back of a portion of each layer of water in the discharge pipe. Each change in diameter of pipe or irregularities due to joints or curves appears to materially increase this slip.

The economy of the air lift lies in its power of supplying a much greater quantity of water from the same sized well, than deep well pumps, except in cases of low submergence when it would be unwise to adopt this method. There is also economy in the absence of working parts down in the well, thus saving the frequent repairing and replacing common to ordinary deep well pumps, and much loss of time and money. In certain cases there is also great advantage in being able to operate wells placed at some distance apart, from one central air plant.

Properly installed and properly looked after it represents, under certain conditions, the least troublesome and a very desirable system of obtaining water from deep wells.

DISCUSSION

Mr. Thornton, (chairman) expressed his appreciation of the paper and remarked that the cost of installation of such a pumping system as described was quite low.



Method of applying air lift to Palmerston wells.

Mr. Richards inquired if compressed air pumps were used to force the water through the distributing mains, and remarked that if such were the case the water would become well treated.

Mr. Smith replied that other pumps were used in the distribution system, but that the water was aerated in the pumping from the wells.

Mr. Wynne-Roberts related an incident where at Midhurst the authorities wanted to test the capacity of a new well. They decided to make the test without consultation with a competent engineer, and pumped very rapidly, thinking they would get the same results in the eight hours as would be obtained in the ordinary twenty-four hour test. The result was that the reservoir was filled with sand and silt.

He stated that the air lift system was efficient in keeping down silt, etc., but the efficiency was low being only 16 to 20 per cent. He differed with the writer as to the method of discharge, saying that the stream discharged with noticeable gushing under ordinary circumstances. He also mentioned the use of the air lift in multiple stages by which water could be pumped from any depth.

Cement Gun Construction at the Hospital for the Insane, Whitby, Ont.

By H. B. Magowan

THERE is now being erected at Whitby, Ont., a Hospital for the Insane, which upon completion will take a position in the foremost ranks of institutions of its kind. The buildings are being erected upon the shore of Lake Ontario on a site which will be virtually a hospital village, the whole scheme being under the personal supervision of Mr. S. A. Armstrong, Assistant Provincial Secretary. The work is now well advanced.

In all details of construction, the aim has been to adopt the latest and most efficient methods. Perhaps in no sphere of activity is this principle more in evidence than in the plaster and stucco work. The fireproof nature of the construction necessarily involves a large amount of plaster work, and it was at once realized that an immense saving of both labor and time could be made by the use of the Cement Gun. Under the superintendence of Mr. H. K. Heathfield, of New York, this equipment is giving the greatest satisfaction, not only as a labor-saving device, but also from the standpoint of quality of product.

In effect, the cement gun is an apparatus designed to discharge mortars directly on to the surface to be coated, by means of a hose and nozzle. After being thoroughly incorporated, the dry materials constituting the mix are placed in a specially designed hopper, whence they are blown by compressed air, along a flexible hose, at the end of which is a double nozzle. This nozzle is furnished with a separate pipe, conveying water, and so arranged that the cementitious materials are mixed with the requisite proportion of water practically at the point of discharge.

It is claimed by the makers that the product of the cement gun, now technically known as "Gunite," is superior in every way to all other mortars. This contention is amply borne out by the results of the work done at Whitby.

This claim to superiority of product is based upon certain definite chemical and physical principles that underlie the method of application.

It is an indisputable fact that when water is mixed with cement, chemical action immediately ensues, resulting in the familiar process called "setting." It follows, therefore, that any subsequent handling or mixing, such as necessarily takes place in hand-mixed mortars, must interfere with this chemical action in its initial stage, and consequently disturb the set.

In the Cement Gun process, since hydration takes place during the application of the mortar, the cement is in its final resting-place when the setting process begins, and there is nothing to interrupt that continuity of hardening recognized by the best authorities as essential to strength of product.

It might be thought that a considerable quantity of material would rebound from the receiving surface and that this rebound would prove a serious loss. In practice, however, it has been found that while a certain proportion of the projected material does rebound, the rejected material consists almost entirely of sand and water. And since rebounding sand can be used again after drying out, no loss of material need be sustained from rebound. Furthermore, it has been demonstrated conclusively that this apparent loss by rebound is in effect a beneficial factor, it being a natural and selective fore-runner of a dense and homogeneous finish.

The cement gun discharges the mortar with a nozzle velocity equivalent to a pressure head of 35 pounds, so that the cementitious material impinges with considerable force upon the surface to be coated, penetrates intimately the surface irregularities, and so ensures an almost perfect adhesion.

Since all surplus sand and water are expelled by the force of impact, there is in Gunite a commendable absence of the faults so common in ordinary mortars, a fact that has been made evident by many exhaustive tests for porosity and permeability. But apart from the question of superiority of product, the fact that the cement gun has effected an immense saving in both time and labor, is sufficient to justify its use at

Cottage at Whitby, Ont., being stuccoed by cement gun process. Walls are built of hollow concrete tile, made at Provincial Reformatory, Guelph. Hopper, with valves, hose pipe, nozzle, etc., are shown in the foreground.

Cement gun in action at Whitby, Ont., showing method of spraying the walls. Note iron pipe conveying compressed air to hopper. Compressors are centrally situated at some distance.

One of the cottages after operation with the cement gun.

Whitby, and indeed on any large undertaking of a similar nature.

The application of mortars by hand is of necessity a very costly and lengthy process, inasmuch as several separate coatings are required to obtain the proper body and finish. The cement gun applies any required thickness of plaster in one operation, and this in less time than the first coat can be applied by hand.

At Whitby, the exterior walls of the buildings are being covered, in one operation, with a coating of stucco plaster three-quarters of an inch in thickness. From carefully compiled records it has been computed that an average net surface of 300 square yards has been completed each day.

In the case of the interior walls, and partitions, these are receiving a one-half inch coating of plaster, and the average day's work for this material has been 634 square yards net surface covered.

The material used for exterior stucco consists of Alca lime mixed with 25 per cent. of cement and 5½ to 7 parts of sand, while the interior plaster consists of Alca lime and sand, without cement. Alca lime is made up of 20 per cent. Alca (Calcium Aluminate extracted from a Cuban slag) and 80 per cent. hydrated lime, which is a high magnesian lime.

The Provincial Government have their own lime quarries, kiln and hydrating plant, at the Central Prison Farm, Guelph, where full advantage has been taken of the natural resources that exist there. The high sand-carrying capacity of Alca lime, not only reduces the expansion and contraction of the stucco, and so minimizes the tendency to crack, but also materially lowers the cost. The sand deposits on the Lake front at Whitby provide first-class material for the extensive concrete work that is being done on the new hospital. It being comparatively free from organic impurities, this sand is particularly well suited for stucco.

In operating the cement gun, each nozzle is directed by one man, followed up by two plasterers who put the finishing touches to the gunite, by hand. Another man is required to regulate the valves that control the chambers of the hopper, while additional labor is necessary to mix the materials and feed the hopper.

An exact costing system is maintained at Whitby, and the data already compiled prove conclusively

Another view of stucco-treated cottages. The streaky appearance of the walls is present only in the photo.

View taken from roof of one of the cottages showing central dining hall and kitchen under construction, cottage ready for plastering, and temporary administration building.

that the cement guns in operation there have effected a large saving.

General Features

When completed the new hospital will consist of over forty buildings and will provide accommodation for some 1,500 patients.

In the constructional operations prison labor is being utilized very largely. All walls, partitions, floors and ceilings will be of fireproof construction. The foundation walls are of concrete, run into the forms on the job. The upper walls and partitions are of concrete. Metal lath is used in all the buildings. A new type of reinforced concrete floor, in which an attempt is made to produce a long span floor, avoiding the use of complicated reinforcement, is being tested. The red roofing tile is being manufactured at the Provincial Government plant near Mimico, where also the supply of upwards of a million brick needed in the construction are being produced.

The sewage disposal scheme was planned by Mr. W. A. McLean, Provincial Engineer of Highways. As there are two drainage levels on the site, it will be necessary to collect the sewage from the lower level in a sedimentation chamber and pump it to the main disposal plant for treatment in contact beds. For this purpose an automatic electric pump will be installed, with an alternative arrangement whereby the effluent can be pumped on to the land of the farm for irrigation purposes in dry seasons. The system provides for the convenient removal of sludge; bacterial treatment by rapid filtration through a bed of crushed stone to break up and render inoffensive the organic matter in the liquid; and finally, chemical treatment to destroy all disease-producing bacteria.

The constructional equipment includes a narrow-gauge railway system for transportation purposes, connecting all sections of the work, and a spur line of the G. T. R., built into the property.

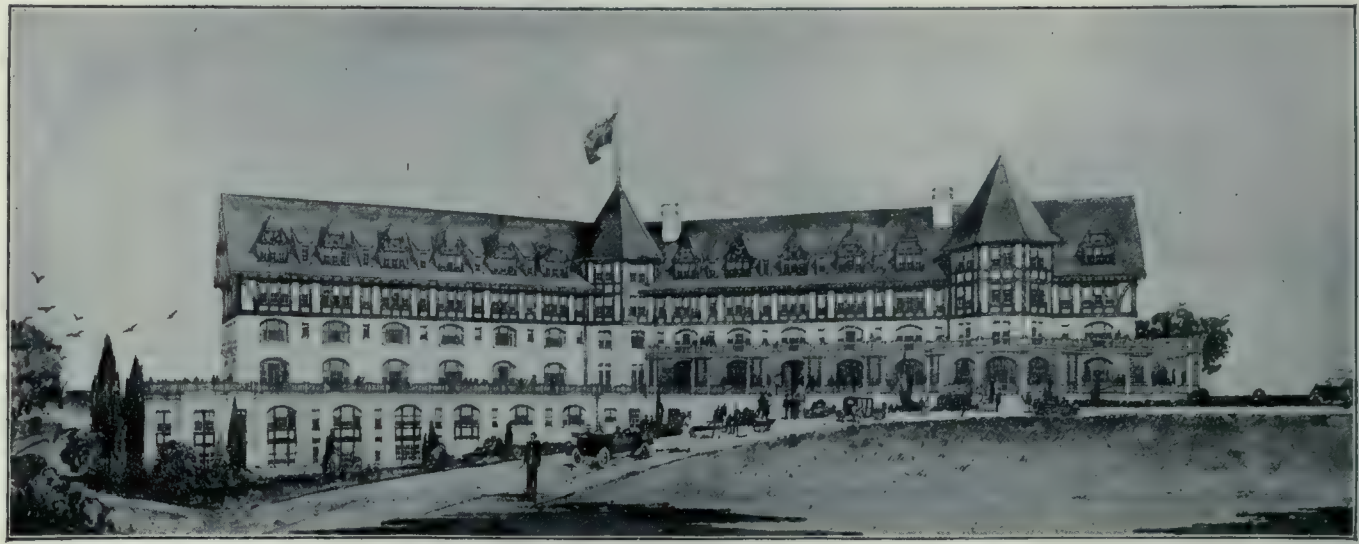
Removal of Wood Block Troubles in Europe

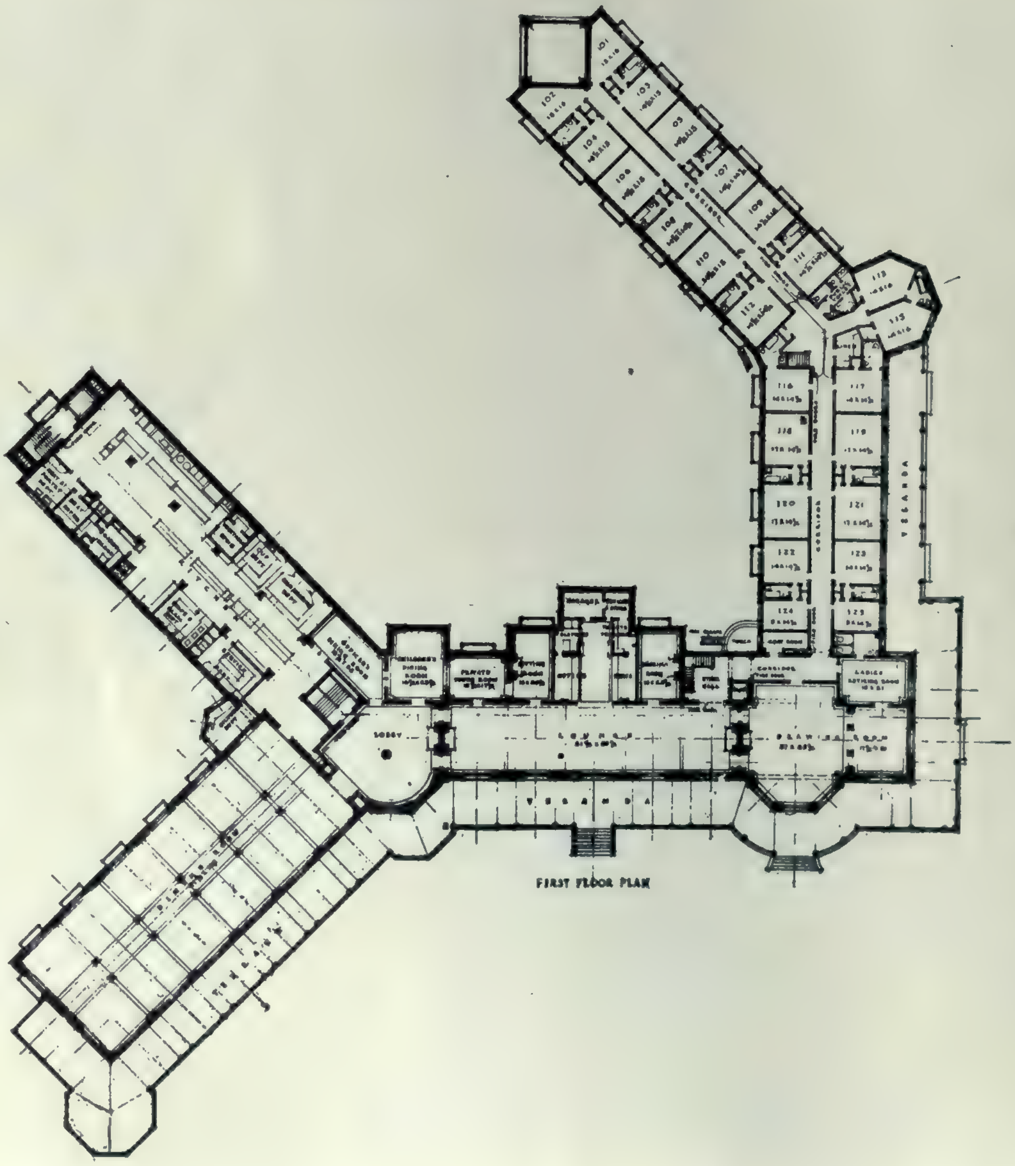
IN a recent paper describing his observations of wood block pavements in Europe, S. R. Church stated that European wood pavements do not bleed, expand or buckle, and are not slippery. He inquired briefly into the reasons to see what we have to learn from their methods. His conclusions follow:

Conditions are so entirely different that I do not see how any direct comparison can be made. In the first place, as to slipperiness, I have already explained that the non-slipperiness of their pavements is due to the use of softer wood. As to bleeding, they seldom have any weather in London hot enough to cause bleeding. In Paris there is not enough oil in the blocks to cause bleeding. The climate also undoubtedly plays a very important part in the question of expansion and contraction. It is agreed that the sudden expansion that sometimes takes place in our wood pavements is due to a rapid absorption of moisture, usually after the pavements have been unduly dry. This can hardly occur in England, where they have a little rain all the time, very seldom any torrential downpours or any long-continued dry spells. The average humidity is high. It is a question whether the pavements ever get dried out to anything like the extent that ours do. I should say that generally the blocks are in a maximum condition of expansion. The same must be true in Paris, or the inadequately treated blocks in that city would certainly bulge. On the other hand, it is well worth considering if the kind of wood that they use has something to do with the lack of expansion troubles. It is manifestly a very different wood from our long-leaf yellow pine. As I have already stated, it does not present as attractive an appearance, and it is probably not so durable. It may be, however, that with short-leaf pine or tamarack or Douglas fir we could obtain results more nearly approaching the European results by following their practice more closely with regard to treatment and methods of laying.

I would also emphasize that the pavements in Europe (this does not apply only to wood) are laid and maintained by workmen who have more conscience, or at least take greater pride in their work than we find on the average job in our country. There is less inspection on the part of the city of the operations of making the blocks and laying them, but I got a very strong impression that the manufacturers are taking no chances of having their material condemned.

In conclusion I want to repeat that in my judgment none of the European wood paving surpasses our best wood streets in appearance.—Municipal Engineering.





FIRST FLOOR PLAN

The New Algonquin Hotel of the Canadian Pacific Railway at St. Andrews, N.B.

Architects
Messrs. Barott,
Blackader and
Webster, Montreal.

Contractors
Messrs. P. Lyall &
Sons Construction
Company, Limited,
Montreal.

Design and Construction of the New C.P.R. Hotel at St. Andrews, N.B.

In April last year the Algonquin Hotel, St. Andrews, N.B., owned by the C. P. R., was almost entirely destroyed by fire. The main building, of frame construction, was completely burned, and only the shells of the two wings were left standing. It was decided to rebuild, and Messrs. Barott, Blackader and Webster, architects, Montreal, were instructed to draw up plans. The contract for the main building was let to P. Lyall and Sons Construction Company, Limited, Montreal, while the restoration of the wings was undertaken by the C. P. R. building construction department, of which Mr. D. H. Mapes is superintendent.

As will be seen by the plans reproduced, it has been decided to adhere to the original plan of a main building with two wings. The hotel will stand on a site covering 28,000 ft. and will be constructed almost entirely of reinforced concrete, terra cotta partitions being utilized in the interior. In order to give an artistic appearance to the front of the main building, a quantity of lumber, embedded in concrete, is employed. The roof is of red slate.

The building, consisting of 4 storeys and two basements, will have accommodation for 200 guests. The basement and sub-basement are, owing to the sloping character of the ground constructed at a lower level than the greater part of the main building. These basements are partly situated in the front portion of the hotel, and are continued under what is known as the kitchen wing. They contain servants' quarters, officers' quarters, helps' dining room, refrigerating plant, bakery, laundry, men's lounge, common room, servery, etc. An open terrace is built over the front portion of the basement, and as higher ground is reached, a verandah is constructed right round one side of the building.

The first floor, entered from the verandah, is arranged so that the lobby is placed between the dining room (41½ ft. x 112 ft.)—the largest room in the hotel—and the lounge (21½ ft. x 89½ ft.). These can also be entered from the terrace and verandah respectively. The drawing room (27 ft. x 38½ ft.) leads off the dining room. Behind these rooms and facing the rear portion of the hotel, are children's dining room, private dining room, sitting room, office, news stand, ticket and telegraph booths, manager's office, smoking room, etc.

The first floor portion of the kitchen wing, which runs off the dining room and lobby, is devoted entirely to kitchen purposes. These include service, dish-washing, cup, vegetable, meat and poultry, knife and glass departments, and officers' dining room. The other wing, leading from a corridor at the side of the drawing room, contains a number of bedrooms.

The entire second and third floors, including the wings, are given up to bedrooms; 97 of these have private baths and 22 have private lavatories. In the attic, bedroom accommodation is also provided, while here is also situated maids' and male helps' quarters, dormitory, and common room.

A boiler house is constructed about 300 feet from the main building. This contains three boilers and two generators for the purpose of providing electric light, power, heat, and hot water.

The keynote of the furnishing is to be simplicity, as becomes a purely summer hotel. Most of the bedrooms and public rooms will have hardwood floors. With the object of minimizing the risk of fire, automatic fire doors have been provided, dividing each floor into five sections, which can be isolated in case of an outbreak. Thus on the first floor there are seven such doors, which can be very quickly brought into operation.

The C. P. R. have in hand all the electrical work; the Garth Company, Montreal, the plumbing and heating; Macfarlane and Douglas, Ottawa, sheet metal and roofing; Murray and Gregory, St. John, a portion of the mill work; while the Otis-Fensom Elevator Company, Limited, Montreal, have the contract for two elevators—one passenger and one freight.

Harbor Improvement Work at Whitby

The harbor improvement work which is being carried out by the Dominion Government at Port Whitby, Ont., is well under way. Dredging and deepening of the channel was completed some time ago. The contract for a new concrete pier, which was awarded in 1913 to Messrs. P. B. Whitney & Company, of Brockville, Ont., is proceeding rapidly. When completed the pier will be almost 1,300 ft. in length. Of this nearly 1,000 ft. have been completed to date. The foundation timbers of the old pier are being used cavation is carried down to these solid timbers, upon which a floor is laid. It is interesting to note that divers are unnecessary, the water in good weather being clear, so that the work can be carried on from heavy rafts. On the floor large concrete blocks are placed, by means of a steam derrick. On top of the blocks a 4-ft. gravel course is laid. The gravel for this purpose is conveyed from the Lake Shore, where large deposits are found. Two feet of concrete for the finish follow this course, making the structure 10 ft. from foundation timbers to surface.

The concrete for the blocks is poured into wooden forms, being conveyed from the mixer in barrels, one gang being kept busy filling these forms so that sufficient blocks to carry on the construction work are always available. The use of blocks in the substructure allows all concrete which is to be laid under water to set before being placed, thus preventing any disintegration of the ingredients. The top course mix is laid wet in the forms.

The pier runs for about half its length along the water front; the other half projects out with the channel, parallel to the lighthouse pier. Work was commenced last summer and it is expected that it will be completed this season.

Careful attention should be given in the design of reinforced concrete structures to the fundamental principles of mechanics of continuous beams and rigid frames, especially at supports and connections.

System of Unit Concrete Construction as Applied to the Power Buildings at Cedars, Que.*

By John E. Conzelman†

THE hydro-electric plant of the Cedars Rapids Manufacturing and Power Company, which is now rapidly nearing completion, is located at Cedars Rapids, on the north bank of the St. Lawrence River, and about thirty miles west of Montreal.

The term "power house" comprises both the substructure, or dam, and the superstructure, or building proper, the foundations of which are formed by parts of the dam. Fig. 1 shows the general arrangement of the development and also gives a cross section of the power house. The power house extends out from the north bank of the river and closes the lower end of the head-race or basin which is formed by the original north bank of the river and by a rock and earth fill dam which extends up the river from the south end of the power house to the head of the rapids.

The power house superstructure may be briefly described as of structural steel frame construction with concrete walls, floors and roof. The transformer house is a reinforced concrete building, supported on spread footings, with concrete curtain walls. The concrete elements of both buildings were "moulded in advance" and were placed in position after the concrete had hardened; certain portions of the transformer house were, however, poured in the usual way.

The Power House Superstructure

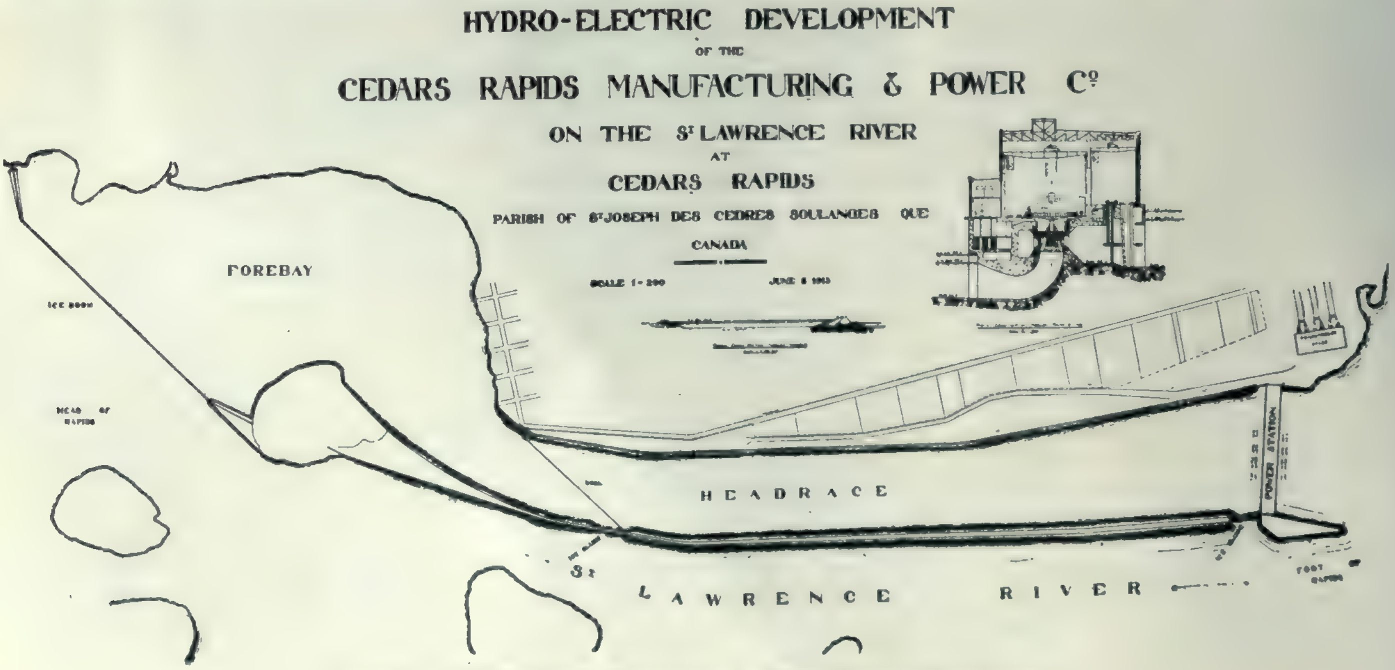
As has been stated, the power house superstructure is built on top of the dam. In order to expedite the work it was necessary that the construction of the superstructure follow closely upon that of the dam so that the mechanical equipment could be installed without delay.

The original sketches called for a steel frame building with brick walls, but this plan was not particularly favored, mainly on account of the expense and trouble incident to transporting to the site the large amount of brick required. There is no direct railroad connection with the property, and carload shipments are sent to Coteau Landing and then transported by barge or car ferry to the company's landing on the Soulanges Canal. The construction of brick walls also necessitates the storage of considerable amounts of materials on the dam. This would have been objectionable as it was desired to leave the top of the dam clear of anything that would hinder the assembling and placing of the turbines and generators.

The question of concrete walls was then considered and this material appeared to be the logical one to use, as the rock excavation was largely in excess of the amount required for the dam and embankments and other concrete work, and the crushing plant could easily supply the required stone. These considerations led to the adoption of concrete walls and roof, and after some study it appeared that a unit method might be well adapted to the construction as there was considerable duplication of parts, and the form work for the high walls and roof would be an expensive item. The matter was finally taken up with The Unit Construction Company of St. Louis. This company reported that the structure was well adapted to unit methods and submitted a tender, based upon their own plans, for the construction of the building. A contract was arranged under the terms of which the contractor was to supply and erect the concrete elements, and was also to erect the steel framework which was, however, to be furnished by the power company.

The details of the concrete work were made by the contractor and the details of the structural steel work were prepared under the direction of the Cedars Rapids Manufacturing and Power Company. The details were finally co-ordinated and the manufacture of units was begun in September, 1913. Casting was continued until cold weather set in and about fifty per cent. of the units for the power house were cast out before December.

It had been contemplated to start the erection of



General plan of Cedars Rapids Manufacturing and Power Company's development.

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*From a paper before the Canadian Society of Civil Engineers, Montreal.

†Chief Engineer, Unit Construction Company, Montreal.

the building some time in October, but it was December before the construction of the dam had progressed to a point where the erection of the steel frame work and units could be started. The erection was continued throughout the winter, but the exceptional severity of the winter, combined with the exposed position, made the erection slow and troublesome. Nevertheless by March 1st seven bays of steel work had been erected, equivalent to a length of 116 ft. 8 ins. of building, and five bays had been closed in with units.

The power house as now built is 642 ft. 4 ins. long and 124 ft. 11½ ins. wide over all, and consists of 35 typical bays 16 ft. 8 ins. long and 3 special bays 18 ft. 4 ins. long; and is arranged to accommodate ten generators, three exciters and ice sluices.

The steel framework was supplied and fabricated by the Phoenix Bridge and Iron Works of Montreal. The roof trusses are designed for a load of 100 lbs. per sq. ft. The crane girders and columns in the main aisle are designed to carry two 150-ton capacity electrically operated travelling cranes. The steel work in the gate house is arranged for a thirty-ton capacity crane. The high columns were spliced at the level of the crane girders.

All connections, except the butt joints between the ends of the crane girders, were rivetted. One expansion joint is provided.

Walls.—All the exterior walls are twelve inches thick and consist of two independent concrete slabs four inches thick, with an air space between. The steel columns were provided with slots to receive the slabs (which were lowered down from the tops of the columns) and after two opposite slabs had been set, they were held apart by a piece of one-inch plank which fitted into notches in the slabs. This board also served as a form for the grout which was poured into the space between the column and the slabs. The purpose of this grout is to hold the slabs in place and also to protect the columns against corrosion. The concrete pilasters were cast in place after the slabs had been erected. The window sills and some of the jambs around the windows were made solid, 12 ins. thick. The doors are of wood covered with copper. The window openings are equipped with rolled steel sash glazed with two thicknesses of double diamond glass, with an air space ¼ in. thick between the lights. The monitor is similarly glazed and the ventilating portions are moved by operators extending down to the level of the main floor.

Roof.—The roof consists of reinforced concrete slabs or units. The roof units consist of a reinforced concrete plate 3 ins. thick cast integral with the beams, which are carried around the four sides, the entire unit resembling the cover of a box. The units are 16 ft. 6½ ins. long and 16 ins. deep over all; those adjacent to the walls, however, have a special slope as shown on the section. The entire unit acts as a beam between trusses; the reinforcement in the beams acting as the tension flange and the entire slab providing compressive strength. A uniform distribution of load on the trusses is assured by the stiff end beams of the units, and the mortar bed upon which the units are set. The roof units are so dimensioned that a space one and a half inches wide is left between the ends and over the centre line of the trusses. These spaces, as well as the spaces between the slabs themselves, are filled with grout. Reinforcing bars three feet long are placed in the space between the units and extending over the trusses. These bars form an effective tie after the grout has hardened. Concrete saddles were formed on the roof for the purpose of directing the water to the downspouts. The roof covering is 4-ply Barrett specification material mopped directly to the concrete. The down spouts are of 18 oz. copper and are brought down inside the building.

The floor of the switchroom, which extends the full length of the power house, was constructed in the usual way, as was also the floor of the tank room which is 3 bays long.

Erection of Units and Steel Work.—Construction was started at the shore or north end of the power house. The structural steel and units were brought to the building on flat cars over a trestle which connected with the high part of the dam. All of the erection was done by means of a structural steel stiff-leg derrick mounted on a triangular steel tower sixty feet high. This high tower and the 84 ft. boom made it possible to complete the erection for the full width and height of the building as the derrick was moved back. The units are provided with lifting hooks or bent steel bars which are imbedded in the concrete when the unit is cast. After the units are in place these hooks are cut off. The weight of the heaviest steel member was about 5¾ tons; the heaviest unit handled weighed about 8 tons.

Manufacture of Units.—The location of the unit yard is shown on Fig. 1. The cement shed was located along a material track and had a capacity of 5,000 barrels of cement; sand and stone were received in six-yard side dump cars. The concrete materials were wheeled to the mixer and water was taken from the Soulanges Canal by a small steam pump operated from the mixer boiler. The mixer discharged directly into distributing buckets of the controllable discharge type and the buckets were handled by a 15-ton Browning locomotive crane with a fifty-foot boom, operating on the yard track. This track extended the full length of the casting yard (about 400 feet), and the forms were disposed on each side of the track for a width of 50 ft.; allowing a strip ten feet wide for the track, the effective area of the casting yard was 36,000 square feet. The forms were supported on 4 in. x 4 in. sleepers which were carefully levelled and bedded on the ground. The sides of the roof slab forms were covered with sheet metal to assist in easy withdrawal of the unit from the forms.

Lifting hooks were cast into the units at convenient places and as soon as the concrete had hardened sufficiently the units were raised from the forms by the locomotive crane. They were then as a general rule taken to the storage yard for further curing, or were placed on flat cars and taken directly to the building.

The detailing of the units involved considerable work; each unit was detailed on a separate sheet and given a distinguishing mark or number which corresponded to the marks shown on the erection diagrams. There are 3,916 units in the power house and 1,602 in the transformer house, the total amount of unit concrete in both buildings being 6,111 cubic yards.

The transformer house is constructed entirely of reinforced concrete and is a four-storey building, with basement. The foundations rest on hard clay at a depth of about seven feet below grade and are designed for a load of 4,000 lbs. per sq. ft. The building is 228 ft. long, and comprises ten bays twenty feet long, and four bays seven feet long.

In order to accommodate the transformers, which occur in groups of three near each end of the building, a special column spacing was used. A length of 47 ft. of building was divided into three equal spaces of 15 ft. 8 ins. each instead of the typical spacing of 20 ft. and 7 ft. Above the third floor typical spacing was used and the columns on each side of the 7 ft. bay are carried by reinforced concrete girders.

The roof is designed for a load of 100 lbs. per sq. ft., the upper floors for a live load of 250 lbs. per sq. ft., except where special loadings occur. The ground floor is of very heavy construction and is designed to support the transformers which were estimated to weigh 75 tons, and also to support a standard gauge track, upon which the special track, or car, for handling the transformers, is to be operated. In addition to the live loads specified all floors were designed for a six-inch concrete finish. The load requirements necessarily resulted in very heavy construction.

The exterior walls consist of concrete slabs 10 ins. thick with a two-inch air space in the centre; the air space was formed by means of a sand core, the sand being washed out before the unit was set. The ends of the building are closed with 6 in. tile walls plastered on both sides as it was desired to have these walls easily removable should the building be extended. The basement walls are 12 ins. thick and are constructed of reinforced concrete except at the ends of the building where brick is used. Below grade the walls are tarred and a drain is provided around the building at footing level to intercept any moisture that may seep in.

On account of the special construction of the ground floor, and because of the lack of duplication, it was decided to construct this floor in the usual way, as well as the extremely high columns which extend about 35 ft. above it.

It had been hoped also, that this division of the work would expedite the construction. It was expected that the foundation and first floor could be completed in the fall of 1913, and that while this work was going on the manufacture of units would be progressing at the casting yard. It was impossible to carry out this programme, however, on account of numerous delays, and it was the end of October before the excavation was started. As a result winter set in when only the footings and a part of the basement walls had been poured; although the forms were up and the reinforcing steel was in place for one-third of the ground floor.

The bottom of the footings was about 3 ft. 6 ins. below the basement floor, and the ground is stratified clay, which is very dense and extremely hard when dry. Shortly after work had been discontinued the excavation filled with water to a depth of almost three feet. This water came in under the snow probably from broken water pipes. It was thought that this heavy snow and ice would prevent the frost from reaching the bottom of the footings. Levels in early spring, however, indicated that there had been considerable heaving. Trenches were dug around some of the footings, and an investigation showed that the water had penetrated the soil, and that between each strata of clay there was a film of ice. The clay strata varied in thickness from ½-in. to 1-in., and the ice films from an inappreciable thickness to 1-16-in. As the construction of the building could not be delayed it was decided to dig a trench around each footing, and thaw out the ground with steam. Some of the footings were 12 ft. x 22 ft. in plan, so the difficulties were somewhat formidable. However, trenches were dug and steam pipes inserted under each footing and kept there until the escaping steam came out on all sides. The treatment was continued until samples showed the ground to be quite hot; the water was then drained away and a form built around the footing to a height of 6 ins. above the bottom. A cement grout was then worked under the footings. This method has proved effective as careful levels have failed to detect any settlement. The net result of the whole operation indicated that time would have been gained if the foundation work had not been started until this spring.

Unit Details.—As stated, the building above the ground floor was constructed according to the unit method. The columns, girders, floor slabs and wall slabs were made at the casting yard and were placed in position by derricks. The continuity and rigidity necessary to a concrete structure of this type was obtained by means of overlapping reinforcing bars which were concreted in after the units were set. The floor slabs rest on the girder ledges for their entire width and the top of the slabs is three or four inches above the top of the girder, forming a grouting space over the girder. Projecting bars extend into this space from both girder and slabs, and this space is filled with concrete. Experience and laboratory tests show that after the grout has hardened the girder is greatly strengthened, in fact T-beam action results. The load was applied at the third points. The simple girders failed in compression, the wing girders in tension. The stress in the steel was computed from the observed extensions. Small holes were drilled into the bars, eight inches apart, at the centre of the span, and the extensions were read to the nearest one ten-thousandth of an inch by means of a special apparatus. Temperature corrections were applied to all readings. The deformation of the concrete was also observed in a similar manner by means of steel buttons set in the concrete 8 ins. apart.

View of power-house—Up-stream side.

Referring to the data on the wing girders it will be seen that the deformation of the concrete wings agrees closely with that of the grout over the girder; this indicates that the wings carried their full share of the compressive stress. In this particular series of tests the compound girders failed at double the load causing failure of the simple girders.

Erection.—A track was laid along the north side of the building and the units were brought down from the storage yard on flat cars. Two derricks were used for the erection. Derrick No. 1 operated on the ground floor and set the building complete to the level of the third floor as it moved back. As soon as the erection had progressed sufficiently Derrick No. 2 was set up on the third floor. This derrick completed the erection up to the roof level as it moved back. These are stiff leg wood derricks, steam operated, with 75 ft. booms.

To complete the erection the lower derrick was placed on the roof and in this position was used to dismantle derrick No. 2, and set the remaining units. The erection of this building proceeded somewhat more slowly than was anticipated, and the delays were mainly due to the interference of the high columns (which had been poured in place) with the movement of the lower boom.

The main transformers are placed on the ground floor; each transformer having its separate compartment formed by solid plaster partitions. The reinforced concrete girders carrying the transformers were designed for a load of 75 tons and extend above the floor level two feet. The transformers rest on 60-lb. rails placed on top of these girders.

All the partitions, with the exception of a six-inch unit wall which extends the full length of the building on the first floor, and some tile and glass partitions around the office, are two-inch solid plaster partitions —cement mortar on metal lath and steel studs. The partitions between the lightning arrester compartments and the transformer stalls are double partitions. The doors to the lightning arrester compartments and those in the partitions on the high tension floors are of wire mesh on steel frames, and are provided with high grade locks.

The roof covering is similar to that of the power house; all metal flashings, except at temporary ends, are of copper. The downspouts are carried down inside the building and are 5-in. wrought iron pipe. The window openings are equipped with rolled steel sash glazed with two thicknesses of glass as in the power house.

As the method of construction which has been used for these two buildings is comparatively new, it may be of interest to say a few words in regard to it. There have been a few buildings constructed of members, moulded in advance, but so far as the speaker is aware, the Unit Construction Company alone has extended the scope of this method so that it can be applied to the construction of almost any structure that would normally be built of reinforced concrete. The basic principle upon which their method is founded is that the necessary stability and rigidity can be obtained, if the joints, which consist of overlapping bars projecting from the units and surrounded by concrete poured after the units are set, are properly made. This principle being admitted the next step is to insure that the bars overlap sufficiently to develop the requisite bond, and are surrounded by a considerable body of grout so that the necessary stresses may be developed.

The chief advantage claimed for this method of construction is that the units can be made under what may be called factory conditions. The forms are strongly built and are carefully bedded on the ground, this makes the proper inspection of the forms and reinforcement an easy matter. Moreover, the unit can be inspected and tested if desired before it is incorporated into the structure. The reinforcement is easily held in its proper position, and is not so likely to be displaced as in a monolithic building where there is always considerable walking over the steel that has been placed.

The location of construction joints is often a puzzling problem in the usual concrete building; with the unit method these joints occur exactly where the designer wants them. There is also more certainty in a unit design as the loads are carried by a definite system of units and not in a more or less ambiguous way as is the case in monolithic construction.

Unit methods are not advisable for all reinforced concrete structures, but for those consisting of a series of similar bays involving a great duplication of parts the method is often the obvious and elegant one. In the case of the power house just described it was certainly an advantage to be able to cast the units some time before the dam or foundation was ready to receive the superstructure.

Constructional Activity in British Columbia

The 5-mile tunnel being driven for the Canadian Pacific Railway under Rogers Pass at Glacier, B.C., at an estimated expenditure of $10,000,000, is an undertaking which is being pushed as rapidly as engineering skill can show the way. On the east end the pioneer bore had been advanced about a mile on October 1, while the 8 x 11-ft. centre heading and the full tunnel section had been driven in 3,100 and 400 ft. respectively. On the west end a 300,000 cu. yd. approach cut was finished, the pioneer bore advanced 1,600 ft., and in the main tunnel portal five small headings had been driven several hundred feet.

At New Westminster there is nearing completion the first unit of an extensive scheme, to cost many millions, for the Fraser River harbor development. Features of this work are the methods of handling material by 150 h.p. electric cranes and a dipper dredge, which were built especially for the work and are supplemented by a Fruhling dredge rented from the Dominion Government. At Vancouver work is actively under way on the joint sewerage scheme and some of the largest trunk sewers in Canada are being built. Sewer contracts totalling $450,000 are to be let shortly.

The Canadian Northern Railway has at present some 86 miles of line and several bridges to complete before trains can be sent through to Vancouver, but it is expected now that the last spike can be driven soon after the first of the new year. The structures for the shops at Port Mann are completed. The Grand Trunk Pacific Railway has practically finished construction on the main line and a regular train schedule has been established, but several thousand men are still at work constructing the branches running southward to Vancouver from Fort George and northward from the latter point to the Pine River Pass.

At Victoria the 10-mile line of 36-in. steel pressure main in the new water supply system was successfully tested under a maximum pressure of 200 lbs. per square inch on October 8. Construction on the 27-mile concrete pipe line, which is 42 ins. in diameter, is well under way. The steam treatment used to hasten the setting of pipe in the molds was unsatisfactory at first and for a while about 15 per cent. of the pipe was culled. However, a more suitable steaming process has been worked out after considerable experiment and culls now amount to a negligible quantity.

The Government breakwater and piers at Victoria are now in the stage where work begins to show above water level. Pouring has commenced on the first two of the concrete cribs, which are to be floated into place and sunk in position as foundations for the superstructure.—Engineering Record.

Features of the Principal Types of American Wharf Design*

THE selection of a proper type of wharf construction, proper not only for the port as a whole, but also for the particular commerce to be handled, is a most insistent problem. No precise formula serves to solve this problem for given conditions. Policy frequently affects the selection of materials for construction and thus frequently the design or type. Finances form another of the factors in the selection of port types.

The majority of our important ports have developed under the pier and slip plan. Provided the fairway or harbor is not too narrowed for ready navigation by the projecting piers, this system has the decided attraction over quays of providing far more wharfage per linear foot of shore front. Desire to secure this greater wharfage has resulted in such narrow piers (50 to 75 ft.) and narrow slips as to cause costly congestion in the handling of merchandise and in the moving of modern vessels. Later designs, unhampered by property restrictions call for piers ranging from 120 to 300 ft. in width and slips varying from 200 to 300 ft. in width.

The open wharf is usually of the pier type, although occasionally its structural features are found in wharves lying along banks which for economy have not been confined by retaining walls.

New York Type

The New York type of open pier is composed of a wooden or concrete floor system resting on a substructure of wooden piles arranged in bents, the piles running up to the under side of the pier deck. The incline bents consist of a single row of piles on 5-ft. centers, and are spaced 10 ft. apart. The four outshore bents are each composed of two rows of piles on 2½-ft. centers and are spaced about 23 ft. apart. The fender system consists of oak fender piles driven at the end of each pile bent with fender capping and chocks to hold the piles in place. Perhaps the most distinctive feature has been the development of the concrete deck with asphalt wearing surface to replace the wooden deck and wearing surface ordinarily used elsewhere.

Cost figures were given by Charles W. Staniford, chief engineer of the Department of Docks and Ferries, in a paper presented to the American Society of Civil Engineers in 1913. The cost of the open pier, assuming the general dimensions to be the same, varies with the lengths of piles. For usual pile lengths it ranges for the single-bent portion of the pier from $1.23 to $1.60 per square foot and for the double-bent portion of the pier from $2.46 to $3.05 per square foot. These figures are for a pier with wooden deck and wearing surface and do not include the cost of any artificial bottom or pile kagging. In the latter about $18 a pile may be added, and $2.50 should also be added for each foot of fendering system. Mr. Staniford gives costs of 87 and 97 cents per square foot respectively with and without asphalt wearing surface. Because of the great sizes of the piers to which he refers the prices may be regarded as low for piers of usual dimensions, say from 60 to 100 ft. wide, and from 500 to 800 ft. long.

The New York open pier is admirably adapted to the natural conditions. Sewage pollution of the waters in the North and East Rivers and the upper Bay, practically permanent, has driven out wood borers, so that the pile substructures are permanent below mean tide. The tidal range averages about 5 ft. Therefore, as shown by severe fires, there is practically no fire risk in the pile substructures between mean water and the pier deck. Over the pier sites the water varies from 15 to 40 ft. in depth, generally too deep for an economical design of solid wharf or filled-in pier.

Philadelphia Construction

As at New York, Philadelphia wharves are usually open piers. Philadelphia, however, has sought to develop a type of pier that will be permanent from mean water up, yet having the cheapness of a wooden-pile subaqueous substructure. Transverse bents of two rows of piles are cut off approximately at 1½ ft. above low water. The bents are spaced 20 ft. center to center, longitudinally of the pier. The piles are clamped and capped, and this framing is covered with a light timber deck upon which are set concrete walls approximately 11 ft. high, these walls being in reality continuations of the pile bents to the pier deck. These cross walls support a system of steel floorbeams overlaid by a concrete deck or a system of reinforced-concrete floorbeams and slabs. On the concrete deck is laid pavement as a wearing surface.

Certain distinctive detail may be noted. The wearing surface of the deck is composed of 4-in. wooden-block pavement. The fendering system does not consist of the usual fender piles, but of fenders bolted directly into the ends of the concrete cross walls and the sides of the floor system. A peculiar feature of this pier is a substructure under the unshedded portion of the outer end of the pier. Extra piles are driven between the two outer bents, and the floor system on which the cross walls rest is extended over these piles so as to floor over entirely the open space between the bents. The cross walls on these outer bents are designed as retaining walls with returns along each side of the pier, thus entirely enclosing the floored-over area. The pocket thus made is filled with earth to the level of the pier deck, on which is laid a concrete slab with wearing surface, this making a very substantial outer end to the pier.

Recently the port authorities requested bids on several modifications of the above design, and also on a design calling for a pier 550 ft. long by 180 ft. wide. Bids ranged from $2.15 to $2.54 per square foot for the New York type, and from $2.23 to $3.07 per square foot for the more permanent designs.

San Francisco—All Concrete

The natural conditions at San Francisco are best met by the construction of the open pier all in concrete, substructure and superstructure. With a tidal range of only 4 ft. 3 in., the deep water close in shore to the established bulkhead line over the pier sites requires the open or pile type of substructure; and, on the other hand, with firm foundation reached from 40 to 75 ft. below sea level there is little apprehension of settlement so detrimental to concrete structures. The bay is so infested with the teredo that the life of the ordinary wooden pile is only from 6 to 12 months. Hence at San Francisco has been evolved a distinctive type of concrete pier. The characteristic feature is the use in some form of large reinforced-concrete cylinders or columns in place of the comparatively small reinforced-concrete pile used in the Baltimore wharf. These cylinders are from 3½ to 4 ft. in diameter, and with reinforcement permit of such concentration of the floor load that they are usually spaced on about 20-ft. centers in both directions. The floor systems were first steel I-beams for stringers and decking, and then steel framing encased in concrete with a reinforced concrete slab. For heavy traffic, vitrified brick has been used as a wearing surface.

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* Abstracted by the Engineering Record from a paper presented at a recent convention of the American Society of Port Authorities.

For cost data, it may be noted that the successful bidder for piers 30 and 32 in 1912 cited the following prices: For cylinders 3 ft. 10 in. in diameter, $3.15 per linear foot; cylinders 3 ft. 6 in. in diameter, $4.93 per linear foot; cylinders 4 ft. in diameter, $4.58 per linear foot. The Fort Mason piers are believed to have cost about $3.35 per square foot.

Portland Construction

Another interesting design of "open wharf" was prepared for the Portland (Oregon) Commission of Public Docks, but has not been followed as yet. The supports of this type of wharf are wooden piles driven in clusters cut off at low water, capped by a wooden and concrete grillage and surmounted by concrete columns or pedestals from low water to the deck level, these supports being centered on 10-ft. squares. This type was designed to meet extreme variations in water levels, where at seasons of low water some 30 ft. of the substructure might be exposed for several months in an extremely dry climate. The fire risk is thus obviated by the concrete columns from low water. On the other hand, the cheapness of subaqueous timber construction was secured by founding these columns on timber, piles being permanent here, since the teredo is absent.

Solid Wharves

In the solid wharf a retaining wall is built on the perimeter of the pier. The area within the retaining walls is then filled by dredging from the adjacent fairway or by fill dumped from the mainland. A usual type of retaining wall is designed as follows: A platform on piles, timber or concrete is constructed, the deck of which is near the level of low water. On this platform is built a retaining wall, sometimes a timber crib, frequently of concrete and masonry. The top of this retaining wall is at the level of the pier deck. The platform is wider than the bottom of the retaining wall, the extra width being to the rear of the wall and acting as a relieving platform. At the rear of the relieving platform sheet piling is driven with a sufficient penetration into the natural bottom. In this way a continuous retaining wall is formed to inclose the pier area, which is then filled in. This type of retaining wall is generally termed as a "relieving platform wall." Its cost varies with the design from $80 to $125 per linear foot. There are many modifications of this platform type of construction. In some cases the retaining wall is founded on piles, steadied by a riprap filling in the front, extending from the natural bottom to the under side of the retaining wall. Since this riprap continues the retaining wall to the natural bottom, sheet piling is unnecessary. Frequently in front of this type of wall a platform on piles is constructed at wharf level. This platform stiffens the wall and provides sufficient depth of water in front thereof for the wharfing of vessels. The cost of this wall is generally higher than the relieving type, running from $150 to $250 per linear foot, depending upon the amount of riprap filling.

Frequently where suitable bottom is reached at a reasonable depth a solid retaining wall is constructed, founded on the bottom and running up to the wharf level.

At Baltimore has been designed a unique type of retaining wall for a solid pier with moderate depth of water alongside. Steel cylinders, afterward filled with concrete, were driven around the outline of the pier, and spaced 25 ft. centre to centre. Between these cylinders continuous sheet piling was driven—the lower end with sufficient penetration to hold at the bottom, the upper ends retained by longitudinal steel and concrete girders running horizontally from cylinder to cylinder, on which they rested. These girders were held back against the sheet piling by tie rods, anchored in reinforced concrete piles inside the prism of thrust.

General Summary

Summing up, experience limits the construction of open wharves to widths not greater than 150 ft., usually from 60 to 100 ft. Beyond this width it soon becomes more economical, except under unusual conditions and great depth of water, to construct the solid type of wharf.

Where the teredo and limnoria are absent and moderate tides prevail and low first costs are desired, the New York pier is preferable. With the same natural conditions, but with a desire for permanency, the Philadelphia design is admirable. Where there is a great variation in water level, especially if seasonal, the Portland plans offer economy and minimum fire risk. With wood borers present and moderate tides and depth of water over firm bottom, Baltimore furnishes an excellent type. For great depths of water and higher tides, the San Francisco pier may well be adopted as a standard.

The employees of Siemens Brothers Dynamo Works have responded with great enthusiasm to the call to arms. A large number of men from their works and offices at Stafford, Eng., amounting in all to about four hundred, have already joined the forces, and, together with the reservists and volunteers from their head office, branch offices and other departments, the total amounts to some 520. The firm is arranging to keep the posts of all these men open, and ample provision is being made for all the dependents of those who have gone to serve.

Public Works Being Carried Out

The Dominion Government, notwithstanding the financial stringency, is carrying out its programme of works under construction. Up to the end of October the expenditure on ordinary and capital accounts exceeded by eight million dollars the expenditure on similar accounts last year.

Uniformity in Compiling and Reporting Statistics of Water Purification Plants

ABOUT a year ago a committee was appointed by the New England Water Works Association to consider the subject of "Statistics of Water Purification Plants," and to recommend certain standard forms for reporting such statistics. A progress report was made at the annual convention of the association held early in September of this year.

The committee divided the subject into five topics, namely, descriptive data, statistics of analysis, engineering statistics, financial statistics and vital statistics. Only the first two topics are covered in the progress report, and these, in only a preliminary way. A final report will probably be made at the next annual meeting. The progress report, with the statistical forms here mentioned, will be published in full in the Journal of the Association. The following excerpts from this report are of wide interest to all water-works engineers and operators.

Descriptive Data

The number of water purification plants in the United States today is very large, and during each year new plants are constructed. Descriptions of the most important plants have been published and may be found scattered through engineering papers, magazines, and official reports. When reading these, it is found that a number of important facts are omitted. So numerous are these omissions that it is impossible from the published descriptions to make compilations of even the most general data which will be adequate. Thinking that it would be of service to those preparing descriptions of filter plants for publication, the following schedule of desirable data has been prepared. Further details would be useful in many cases, but the following items in connection with the study of the operation of a purification plant are always important:

1. City or town, and population at last census. 2. Name of owner. 3. Name of designer. 4. Date when plant was put into service. 5. Total cost, with statement as to what is included. 6. Source of supply. 7. Rated capacity. 8. Method of purification. 9. Total capacity of subsiding or coagulating basins. 10. Total capacity of filtered water basin. 11. What chemicals are applied. 13. How applications of chemicals are applied. 15. Net area of filter surface. 16. Depths of filtering materials. 17. Sizes of filtering materials. 18. For slow filters—arrangements for cleaning sand surface, sand handling, sand washing. 19. For mechanical filters—method of cleaning filter beds. 20. Number of subsiding or coagulating basins. 21. How the rate of filtration is controlled.

Statistics of Analysis

Blanks illustrating the committee's recommendations regarding the form of report, the tests to be made and the method of expressing results, are incorporated in the preliminary report. These blanks are seven in number and are referred to as numbered tables. They give: Chemical and microscopical character, turbidity and color, and bacteria in raw water; also the chemical character, the turbidity and color, total bacteria, and number of B. Coli in the water delivered to mains. These tables are arranged to show the analytical data by months and years. The terms used in the tables are all fully explained.

Essential Determinations.—The elimination of unnecessary analytical work is a matter that needs consideration at this time. Laboratory practice at various purification plants has shown that many of the determinations which are ordinarily included in the standard water analysis schedule are here of little or no importance. For example, the determination of nitrogen in the usual forms of free and albuminoid ammonia, nitrites, and nitrates serves no particular purpose in water purification except in special cases. They neither assist the superintendent in the operation of the filter, nor give any adequate idea of the safety of the filtered water. On the other hand, some of the simpler physical tests, such as numerical determination of turbidity, color, and odor, microscopical examinations and tests for alkalinity, iron, and carbonic acid, have come to be regarded as most valuable; and in special cases various other tests, such as dissolved oxygen and manganese. Bacteriological tests are, of course, important.

Sample for Analysis.—One step in making an analysis of water has never received half the attention that it deserves, namely, sampling. Of what value is it to use analytical methods of great refinement if the samples themselves are not representative, if the mass of water from which the sample is taken is not homogeneous, or if the water changes in character from one day to another? Samples for chemical analysis are almost never larger than 1 gal., and samples for bacteriological analyses are seldom larger than 100 c. c., while the quantities actually used for the different tests are still smaller. In counting the number of bacteria, the quantity used is less than a thimblefull.

On the other hand, we know that bodies of water are not homogeneous. In a lake or settling basin there are vertical and lateral variations; a river is constantly changing, not only in volume but in the character of the water; filter effluents vary, especially the effluents from mechanical filters where the runs are short and the rates are high. The causes of these variations which affect the results of water analyses through unfair sampling are so numerous that they cannot be studied by themselves, and the only course left is to apply to them the laws of probability, or, in other words, to arrange the data secured in some such way that the importance of the inevitable variations may be indicated and an index of the character of the water examined be obtained.

Thus we see that a question of fundamental importance is that of frequency of collecting samples. The question is: How often must samples be taken to obtain reliable results? As a general proposition it may be stated that the frequency of sampling should depend upon the frequency of change in the character of the water examined. For a water of constant quality, a few samples taken at infrequent intervals may serve to give a fair idea of the water, but if a water be subject to great fluctuations in character, a few samples taken at long intervals might or might not give a fair idea of the water. The reliability of the average result will be determined by the laws of probability. The average result does not tell the whole story, for it eliminates the individual results, and a water supply should be safe and wholesome all of the time.

The frequency of sampling has a limitation, which is controlled by practical and financial considerations. In a small plant the cost of daily analyses would usually be prohibitive, and even weekly analyses might be a burden. It would be recognized, however, that results based on infrequent samples are less valuable than those based on frequent samples; and that irregular sampling gives the most unreliable results. In order to emphasize this point it seems desirable to establish certain grades of control of operation, based upon the character of the records kept, as follows:

First Grade: Water purification plants under first-grade supervision are those where analyses of the filtered water are made one or more times a day, and where engineering and such other data regarding the operation of the plant as are necessary are collected by one or more attendants constantly employed.

Second Grade: Water purification plants under second-grade supervision are those where analyses are made regularly, say once a week or once a month by a trained analyst, and where an attendant constantly on duty makes simple daily tests.

Third Grade: Filter plants under third-grade supervision are those where analyses are made irregularly and infrequently, and where no daily tests are made by the attendant.

This grouping should not be considered as necessarily casting a stigma upon second or third-grade supervision. Some water supplied may not demand first-grade records. In general it may be said that the safer the raw water, the lower may be the grade of analytical supervision. In other words, polluted waters require the purification plant to be operated with a higher factor of safety, and to this end a more careful analytical control is needed. Stored waters are safer than unstored waters, and with them a lower degree of analytical supervision may suffice. A corollary to this would be that small plants which cannot afford high-grade supervision of filters should endeavor to protect the quality of the supply by storage or by incorporating a large factor of safety in the design of the plant.

Efficiency of Operation.—No provision is made in these tables for recording the percentage of bacteria, a method that has been much used in the past. While this method has certain advantages, it is so susceptible to misuse that the committee recommends that it be omitted from official reports of filter operation. The reasons why the percentage removal method is unsatisfactory were discussed at some length by the committee. Eight reasons were assigned for abandoning the "percentage removal" method of gauging the efficiency of a filtration plant. The reasons follow:

(1) The bacteria found in the effluent are not all derived from the raw water. A certain and varying number of them represent growths in the lower part of the filter. The bacteria from this source do not vary in number with the number of bacteria in the raw water, but with the rate of filtration, with disturbances occasioned by the collection of air within the filter, and with other factors of operation.

(2) It requires a certain time for the water to pass from the point where the raw water sample is taken to the point where the filtered-water sample is taken. Sometimes this amounts to several hours, and in the case of a water which changes rapidly in quality and character it is necessary to make an allowance for this time f ia correct comparison is to be obtained. As a matter of convenience it is common to collect samples of the raw and filtered water at about the same time. Hence there may be an error due to this difference in phase. Whether or not this is of importance depends upon the uniformity in the character of the raw water.

(3) The percentage removal is to a certain extent a function of the number of bacteria in the raw water. It is a well-known fact that the percentage removal of bacteria is relatively high when the raw water contains large numbers of bacteria and relatively low when the raw water contains few bacteria.

(4) The percentage removed does not necessarily vary with the number of bacteria left in the filtered water. The following is an example:

Day	Nos. of bacteria.		Percentage removed.
	Raw water.	Filter effluent.	
First	50	3	90.4
Second	1,000	10	99.0
Third	600	20	96.6
Average	555	11	

It will be noted that on the day when the number of bacteria in the effluent was lowest, the efficiency as shown by the percentage removal was also lowest.

(5) The infectiousness of a water does not necessarily vary with the number of bacteria in the water, but in most waters there will doubtless be some connection between the two.

A water polluted with surface wash would doubtless increase the infectiousness, and the numbers of bacteria would increase with increase stream flow. On the other hand, a water regularly polluted with sewage, other things being equal, would increase in infectiousness as stream flow decreased, that is, as dilution became less, while the numbers of bacteria under these conditions might decrease. Hence, there seems to be no very definite relation between the infectiousness of a filtered water and the percentage removed of bacteria by a purification plant, which percentage varies according to the numbers of bacteria in the raw water.

(6) If any comparison is to be made between the numbers of bacteria in the raw and filtered waters it would be better to use the "percentage of bacteria remaining," partly because the numbers themselves are smaller and easier to handle, and partly because the figures show to better advantage the variations in the operation of the filter; for example, when two filters, with the same raw water, are operating so as to produce 98 and 99 per cent. "removals" of bacteria, respectively, the numbers of bacteria remaining in the effluent of the first will be twice as many as in the effluent of the second. Again, comparing one filter with an efficiency of 99 per cent. with another filter with an efficiency of 99.9 per cent, both operating with the same raw water, the diffierence at first sight seems small, yet the effluent of the first of these filters contains ten times as many bacteria as the effluent of the second. Hence, the method of stating efficiency of a filter plant in terms of "bacterial removal" may be misleading.

(7) A single figure showing the percentage removal of bacteria during a certain time—as, for example, a month—gives no idea of the regularity of operation of the filter during this period.

(8) A common fault of filter specifications is the provision that the plant shall show a certain percentage removal of bacteria when the numbers of bacteria in the raw water are below a certain limit. This specification is inadequate. A good water purification plant is one which produces a satisfactory effluent every day of the year and every hour of the day; and, if efficiency can be expressed on a percentage basis, it should be indicated by the percentage of the time during which the plant produced a good effluent, rather than by the percentage comparison of bacteria in influent and effluent respectively.—Engineering and Contracting.

Paving Floors Like City Streets

THE ideal shop floor is that one which has sufficient durability to withstand the required service and at the same time tends to increase shop efficiency and decrease labor costs.

Just as city engineers have sought a street paving material which would require a minimum of repairs, so have shop managers been always on the look-out for a durable floor which would successfully withstand hard service, prove as easy under foot, be smooth, have a low tractive resistance, be dustless and sanitary and which could be easily taken up and replaced for necessary repairs to underlying pipe and conduit.

Shop floors have been very generally experimented with in an endeavor to find materials which fulfill these conditions imposed by hard service. Machine shops are especially hard on flooring material.

A modern factory floor should meet the following requirements:

It must be resilient and untiring to the workmen. To accomplish their work, men must be comfortable. Where work requires more or less constant standing, the floor for ideal conditions should not be cold, hard or damp.

It must be smooth and have a low tractive resistance so that trucking costs may be low.

It must be durable, thus eliminating the necessity of frequent and costly renewals.

It must be constructed of a material which is a poor conductor of heat.

It must be dustless. Floors which disintegrate or pulverize into grit and dust are harmful to the bearings of machines.

It must be sanitary.

It must be hard but resilient.

It must be noiseless.

It must be impervious to the effect of acids and oils as well as to moisture.

Practically all floor materials meet one or more of these requirements. That floor is best which conforms to the greatest number.

Many managers have watched the success which has followed the use of wood blocks in paving city streets and have used this material for their factory floors. When treated with creosote they are not subjected to the rapid decay which, under some conditions, affects untreated wood blocks or planks.

As the blocks are laid with the grain up they present a surface like the face of a mallet and so wear smoothly and uniformly even under heavy trucking Since wood is a poor conductor of heat, there are no complaints from the workmen of cold and hard floors as is frequently the case where other materials are used for the purpose.

Floors of wood block do not disintegrate or pulverize into grit which injure the bearings of machines and where impregnated with creosote oil they have an antiseptic property which adds to their value from a sanitary point of view and further makes them free from the action of acids and oils and impervious to moisture. Floors of this material have the same advantages of noiselessness that wooden paved streets enjoy.

Sharp edged tools are continually being dropped on factory floors and in this way are often dulled and broken. Such is not the case with wood block flooring because of its resiliency.

Factories which use the wood block flooring find that it has advantages when it is necessary temporarily to take up a portion of the floor in order to make repairs to underlying portions of the structure.

The ideal method of laying a wood block floor is to provide room for any possible expansion between each block. Specifications often call for a quarter inch space left between the ends of each block to take care of this expansion element, but in actual practice it is often difficult to enforce its compliance.

Specification for Sand in Reinforced Concrete

IT is generally acknowledged that the specifications most frequently used for sand are inadequate in that they are too brief or too indefinite to secure the desired results. Recent specifications have overcome these defects in some respects, but most of them are objectionable in that they are too inflexible, i.e., fail to allow variations in the quality of the sand to meet varying conditions or different requirements, or else by placing undue stress on some particular requirement bar from use sands which would prove entirely satisfactory. The following specification is given in Bulletin No. 67 of the University of Illinois and has been prepared with the idea of giving the necessary flexibility and general guidance in drawing up the specification for any particular piece of work.

Definition of Sand and Screenings.—The term "sand" shall be understood to mean natural sand which will pass, when dry, a screen having ¼-in. clear openings. Similar material which is the product of artificial crushing shall be known as "screenings," and shall conform to the specification for sand.

Specification for Sand

Composition.—The sand shall consist of grains from hard, tough, durable rocks, and be free from soft, decayed, or friable material.

Cleanness.—The sand must be free from lumps of clay, loam, or other foreign material. It shall not contain more than 2 per cent. by weight of finely divided clay, loam, or other suspended matter when tested by washing in such a manner as to remove all such material without removing any of the finest sand; provided that if the strength of the mortar made from the sand is greater than 110 per cent. of the strength of a similar mortar made with standard Ottawa sand, the amount of suspended matter may reach 3 per cent. This suspended matter must not form a coating around the grains to such an extent that such coating is not entirely broken up and removed from the grains by sprinkling with water or in the mixing of the mortar or concrete. The sand shall be free from oily or greasy matter in any form and must contain no organic silt.

Roughness—The grains shall have rough, unpolished surfaces to which the cement paste will readily adhere.

Size of Grains.—The grains shall be well graded in size from the finest to the coarsest. For the greatest density not more than 8 per cent. by weight, including the suspended matter, shall pass the No. 100 sieve, and not more than 60 per cent. the No. 16 sieve. If maximum density is not essential and the mortar yields the required strength, these quantities may be increased to 12 per cent. and 75 per cent., respectively.

Voids.—The voids in the dry sand, when well shaken, shall not exceed 33 per cent. of the total volume of the sand.

Tensile Strength.—Mortar, in the proportions of 1:3 by weight, when tested at an age of 28 days, shall develop a tensile strength at least equal to the strength of a similar mortar made of the same cement and standard Ottawa sand tested at the same age.—Ferro-Concrete.

Data Relating to Wear and Cost of Concrete Roads With Details of Maintenance Expense*

By W. S. Shaw

ENGINEERS over the entire country are realizing that a concrete pavement made of carefully selected aggregates, properly proportioned, mixed, and placed offers a solution for many paving problems, and is a method of construction possessing inherent merits well worthy of investigation. As a result of a number of years of experiment during which time many methods of construction were tried out general practice has narrowed down to two types, known as the one and two course pavement, with the one course paving meeting general favor. While concrete has been a comparatively modern paving material, still we have authentic record of paving laid at Bellefontaine, Ohio, in 1893-94. This pavement was laid in two courses very similar to the present day method of laying sidewalks, the entire pavement being divided into 5-foot squares. After twenty years' wear the pavement is in excellent condition except the longitudinal joints between many of the squares. These have worn away considerably, but even at that the total cost of maintenance on four city blocks around the Court House, subject to the traffic of a town of 6,000 to 8,000 inhabitants, in twenty years has been less than $300. Had longitudinal joints not been used, and the best modern methods of paving do not countenance their use, this Bellefontaine pavement would be in first class condition to-day.

Owing to the smooth uniform surface which sheds water very rapidly, it is possible to construct these pavements with a very low crown, eliminating the slipping and skidding which accompany any high crowned road and distributing the traffic over the entire surface of the pavement; for it is a noticeable fact that on any high crowned road the tendency of traffic is naturally to use the crown, thereby concentrating the main part of the traffic in two narrow ruts which cause the centre of a macadam road to give way leaving the sides practically untouched, a very serious drawback to a high crown road construction, yet an insurmountable one with macadam or gravel.

While the specifications for this work may vary a little in various localities, due to local conditions, still in general the following methods if carefully followed will produce good results in any locality. In brief, the paving should be constructed of a 1:2:3 mix, the coarse aggregate to be retained on a ¼-inch and pass through 1½-inch screen. The fine aggregate should not only be clean and free from loam, but must be well graded and of sufficient hardness and toughness to resist abrasion and the effect of the steel tired traffic. The slab should have a minimum thickness of six inches with a crown of not less than 1/100 of the width of the road and not more than 1/75. Expansion joints should be placed three or four every hundred feet, and where the paving is 20 feet or over it should be reinforced.

Too great care cannot be exercised in selecting proper aggregate. Wherever possible to do so it will more than repay engineers to have the aggregates they propose using tested in order to ascertain definitely their quality.

The first step in constructing a hard surface pavement is the preparation of the subgrade or base, really the foundation of the road. This subgrade should be reduced to the desired level and thoroughly rolled so as to produce a firm, hard, uniform surface. Any soft spots should be eliminated, if necessary dug out and filled with stone or other hard material and the surface sealed with some fine material so as not to permit mortar from the concrete to seep into the stone filler.

The question of draining the subgrade is a problem which varies considerably in different localities, but the ultimate results desired are a drainage system which will keep the subgrade at all times well drained to eliminate settlement or washouts and heaving from frost action. Very often the fact that a subgrade is rolled harder in the centre than at the sides will be sufficient cause for settlement.

The method that has been generally adopted for eliminating these cracks is to place expansion joints every 25 or 30 feet across the pavement, cutting entirely through the slab and filled with some plastic and resilient material which will stand the wear and tear of traffic and weather, such as tar asphalt or asphaltic felt. The great trouble with these fillers is that they do not protect the sharp edge of the concrete slab. This has led to the adoption of armored joints; the armor consisting of two thin sheets of steel bent to conform to the crown of the road with members sheared out at intervals and bent back to bond into the concrete. These joints are clamped together with a filler between them of tar paper or felt, and when properly placed the results are excellent. The frictional resistance offered by a rough base to the movement of expansion and contraction is more likely to have a serious effect on the slab than if the base were smooth. For this reason a flat, rather than a crowned, subgrade is recommended.

After the subgrade is ready and forms, preferably steel, have been placed to grade, the concrete which has been mixed in a batch mixer to a mushy consistency is placed on the freshly dampened base. This concrete is then struck off with a template, its striking surface being faced with steel and the extreme ends resting on the side forms. This operation reduces the concrete to a roughly finished grade, which is then floated by finishers working from a bridge. On ordinary grades the coarse aggregate is worked under the surface of the mortar and the finish left on the road is the ordinary texture of the mortar itself, a smooth trowelled finish similar to that on a sidewalk not being desired or required. A steel trowel should never be used. On heavy grades, say from 8 to 18 per cent., some artificial roughness may be provided if desired.

After the concrete has hardened sufficiently it should be covered with loam or sand to a depth of a couple of inches, and then kept thoroughly moistened for a period of 10 to 14 days, depending on climatic conditions. While in some instances it has been considered feasible to turn traffic on a newly laid pavement fifteen days after it is laid, it is a mistaken policy to use a newly laid road befort thirty days.

Wayne County, Michigan, has constructed since 1909 about eighty miles of concrete highway, built almost entirely by day labor under personal supervision of the county commissioners. The aggregates were shipped a distance of about 160 miles, and their pavement cost them from $1.04 to $1.74 per square yard including excavating and drainage, an average cost of $1.27. The maintenance on these roads has been less than $28.00 per mile per year, an extremely low figure to keep the surface of any road in condition.

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* Paper presented before the Engineers' Society of Pennsylvania.

Mason City, Iowa, in 1909-10, laid 30,000 square yards of concrete paving with a maximum thickness of 7 inches in the slab at cost of $1.26 per square yard. There has been no maintenance on this to date.

The State of Maryland has laid a number of miles of concrete highways in the last two years. These roads have been laid over treacherous clay subsoils; through marshes along the eastern shore, and have come through these tests most successfully. The pavement which has already been laid in that state has cost from $0.98 to $1.35 per square yard, exclusive of drainage, and the maintenance up to date has been practically nothing.

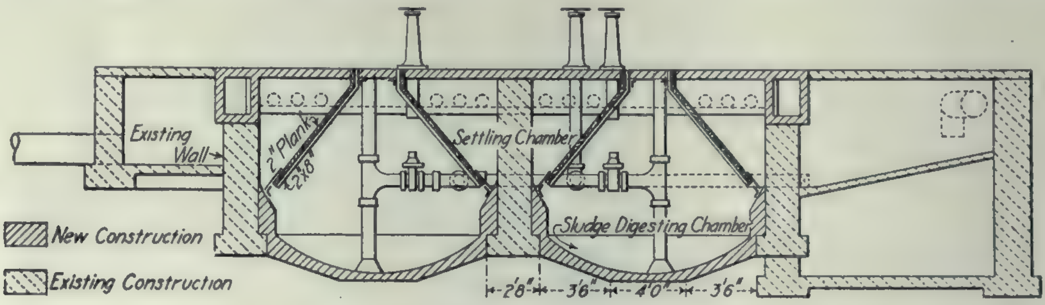
At the National Conference on Concrete Road Building in session at Chicago, 1914, a committee reported that the average cost of concrete pavements and highways in forty-two states was $1.24 a square yard, exclusive of drainage and excavation, as authentic figures on this part of the work were not available.

Remodelling a Septic Tank and Contact Filter Sewage Plant

By Alexander Potter, Consulting Engineer, New York

By changing old septic tanks into two-storey Imhoff tanks and converting existing contact beds into sprinkling filters the sewage treatment plant at Moorestown, N.J., built in 1901 to treat 250,000 gal. daily, has been remodelled to handle a daily flow of 500,000 gals.

From a grit chamber sewage entered an open brick septic tank 75 ft. long, 25 ft. 6 ins. wide, with an average depth of 1 ft. Two 20-in. brick walls divided it into four equal compartments arranged so that two, three or four of the chambers could be used at any one time.



Cross-section showing old work and modifications.

The contact bed was divided into four units, each 85 ft. x 42 ft., area, each inclosed by 16-in. brick walls. Three of the beds were filled to a depth of 4 ft. with slag ranging in size from ¾ to 1½ ins.; the fourth bed was filled with cinders.

The work of remodelling consisted in removing the existing bottom and excavating to an additional depth of 2 ft. 4 ins. As the new bottom was carried below the foundation walls of the old tank it was built in the form of an arch to give the necessary stability to the walls and to assist in the removal of the sludge. In the old septic tank the level of the liquid was maintained at El. 15. In the remodelled tank this was raised to El. 15.5, necessitating the raising of the outside walls a height of 6 ins. These changes increased the depth of the tank from 7 ft. to 9.5 ft.

The remodelled tank consists of four units each of which is again divided into three compartments by a false bottom constructed of 2-in. creosoted yellow-pine. This false bottom makes a slope of 40 deg. with the vertical. The upper two compartments are settling compartments and the lower and larger compartment is the sludge digestion compartment. The total settling capacity amounts to a retention of 1.35 hours when the plant is operated at the rate of 500,000 gals. daily. The total capacity of the sludge digestion chamber figured below the level of the walls is 5,470 cu. ft., about 50 per cent. larger than required by established practice. Three 6-in. sludge pipes extend down into the sludge digestion chamber of each unit.

Cost of Remodelling

The cost of remodelling the plant and enlarging it 50 per cent. to adapt it to the present flow was as follows:

Cost of Remodelling Plant

Remodelling septic tank into two-storey tank	$3,100
Construction of dosing tank, siphon and piping ...	1,800
Sprinkling filter, ¼ acre	8,300
Sludge bed and piping	300
Additional piping around plant	1,300
Final settling basin	500
Total	$15,300

The cost of remodelling the contact beds into a sprinkling filter was somewhat more than was expected as it was found that less than 10 per cent. of the filter medium of the original beds could be used in the new filter.—**Engineering Record.**

Unusual activity in the manufacture of barbed wire is reported by Canadian steel mills. Large orders are coming in from the allied armies and nearly every plant is working to capacity. It is said that in some cases orders running into thousands of tons have had to be refused owing to the impossibility of making delivery.

The Effect of Leaking Illuminating Gas on Bituminous Pavements[*]

By George C. Warren

To everyone who has had long experience in bituminous pavement construction and maintenance it is well known that illuminating gas escaping from subsurface gas mains is very injurious to all forms of bituminous pavements, and yet we frequently find representatives of gas companies and city officials ridiculing the idea that gas can have any effect on such pavement surfaces.

The fact is that illuminating gas, a bituminous substance, and hydro-carbon, quite similar in its chemical composition to light tar and oil distillates, is lighter and more penetrating than the distillates and even more rapidly attacks and liquefies a bituminous cement, no matter whether the bitumen be a tar or an asphaltic product.

In my thirty years of experience with asphalt and other bituminous pavement construction this matter has come up many times, and generally the persistent claim of the gas companies is:

1. That it is ridiculous to suppose that gas will attack an asphalt pavement.

2. That the gas mains have been carefully tested by plugging holes through the pavement and into the ground and that there are no leaks.

3. When the main is on the side of the street opposite a portion of the street affected, it is too far away.

I would comment on these points as follows:

1. There can be no question but that coal gas, being a hydro-carbon in gaseous, and therefore its most penetrating form, will attack any form of bitumen even more rapidly than oil, just as gasoline, being more penetrating, will attack bitumen more rapidly than heavier oil, such as machine oil, for instance.

I particularly remember one extremely aggravated case on West End Avenue, New York City, about fifteen years ago, which became reaffected, and the asphalt pavement again ruined within three months after it was resurfaced, the gas company having claimed that they had thoroughly tested the mains and repaired the leaks. Shortly, subsequent to this, the gas company was obliged to entirely relay the gas main and the pavement was again relaid.

2. Even if they dislike to, or will not admit it, the gas companies well know that the "plugging" test only sometimes locates the leaks. They naturally dislike to go to the expense of tearing up and relaying pavements and excavating to and uncovering the mains unless the conditions become such that they are absolutely required to do so.

3. The leaking gas naturally follows the lines of least resistance, which may be in either a nearly vertical line and show the result almost immediately above the leak, or, what is extremely hard to find, may follow a long distance through a vein of porous earth or along the space formed by some old settled trench and reach the pavement surface a long distance from the leak. In such cases the pavement is generally affected over a large area, because the earth has become quite generally saturated with the gas, which gradually works up to the pavement surface.

I remember a case in about 1888, on Rutger Street, Utica, N.Y., where the first indication of trouble in the gas main was the effect on the asphalt pavement. The gas company claimed they had repaired the leak and a considerable area of pavement was relaid. About a month later an elderly couple, while asleep in one of the residences nearly a block away, was nearly asphyxiated by gas leaking from the street. Probably the gas had first found a partial outlet, following along a vacancy in some trench settlement, and then through the pavement. Subsequently the leak became worse, with the serious result referred to above.

Frequently, if not generally, the first indication of leak in the gas main where the street has a bituminous pavement is the effect on the pavement, in which case it is good fortune that the pavement is of a character which is affected by gas and will permit the gas to permeate the surface, thus lessening the chance of serious casualty as above outlined in Utica.

The visible effect of leaking gas on a bituminous pavement is a serious "shifting" or "rolling" of the pavement in its softened condition, accompanied by a breaking up of the surface into a "crackled" appearance not unlike the folds or cracks in an alligator's back.

Generally, when this condition is noticed, a perceptible odor of gas will be found in the pavement surface, but sometimes the leak may have been repaired or the gas taken another course and the gas escaped so that its odor cannot be detected, yet the pavement is left in a seriously damaged condition. On the other hand, under certain subsoil conditions, the earth below the pavement may retain the escaped gas and continue to have its damaging effect for months, if not years, after the gas main has been repaired and the cause of the trouble probably removed.

The effect on the pavement may extend for a considerable period beyond the repairs to the gas main unless steps are taken to provide frequent vents, left open for several days, if not weeks, after repairs to the gas mains are made.

In such cases, before making repairs to the pavement, its entire surface over the main and where the surface shows the effect of gas should be removed and the gas main should be thoroughly repaired(renewed if necessary). After the leaks are repaired vents or openings at least 1 ft. square, extending from the surface to the level of the gas main, should be left open for two or three weeks or longer, if there is still any odor of gas, and the openings then refilled and thoroughly tamped and the pavement surface relaid. With this precaution the trouble will probably be overcome if the gas company has not been too parsimonious, inefficient or incomplete in making of repairs to the gas mains.

In conclusion it may be well to call attention to a pernicious but quite general custom of the gas companies in their "hunt" for leaks. I refer to the custom of having two or three men, one of them selected for his "smelling" efficiency, go along the street where there are indications of gas leaks, hammering a cone-shaped bar through the pavement into the ground below. These holes are made at intervals of a few feet. The "smeller" man puts his nose to the holes, and if he discovers a sufficient odor of gas to attract his attention an opening is dug to try to discover the leak. If the "smell" test does not locate a leak apparently below the hole it is quietly filled with dirt. A few weeks later the city official, or the "poor devil" of a paving contractor, if he happens to have the pavement under "guaranty," finds serious holes along the centre line of the pavement and, not being able to trace the trouble to any cause, he makes the repair, if his "guaranty" is good, or "lets it slide" if he and his "guaranty" are no good, and perhaps at the end of a lawsuit the city makes the repairs.

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[*] Abstracted by Engineering and Contracting from a paper before the American Society of Municipal Improvements.

The simple, but so far as the writer knows never enacted, cure for this evil is an ordinance requiring gas companies, whenever they want to test their mains, to cut openings of sufficient size through the pavement to enable excavation to the gas main, absolutely prohibiting the promiscuous drilling holes through the pavement as above described, and to pay for making a proper repair to the pavement. With the enactment and enforcement of such ordinances the chances of locating the leaks are greatly increased and the unfairness to the city and contractor of making holes in the pavement without adequately repairing them will be eliminated.

A paper read before the Institution of Electrical Engineers some time ago deals with the fundamental laws governing electrolytic corrosion of iron in soils. Experimental data are given showing the effect of the different factors that are most likely to influence electrolytic corrosion of buried pipes under practical conditions, such as current density of discharge, moisture content of the soil, presence of oxygen, temperature, voltage, and other factors. The effects of earth resistance, polarization, and surface film resistances are also discussed briefly, and tables are given showing the results of specific resistance and corrosion tests on a large number of soils taken from widely scattered sources, which give an idea of the order of magnitude of the values of resistance and corrosion efficiency that may be expected under average practical conditions. A number of conclusions are presented showing briefly the effect of the different variables involved and their relation to some practical aspects of the subject of electrolysis.

As several of our office force often have occasion to be away, sometimes for several days during each week, it became necessary to provide a plan whereby the regular office correspondence can be reviewed on the return to the office of any of the force, writes a Boston correspondent. This is especially important in our line of work for many times a letter will demand an immediate temporary reply, while the person to whom it is directed may be absent. On his return, the details must be taken up with as little delay as possible. To meet this condition we provided two daily files in the form of expansible folders with alphabetical indexes. One of these files is used as a temporary file during absence of any of the office force. On his return, it is but a simple matter quickly to review all correspondence while the plan offers a very simple method of readily locating letters which may be needed before filing in our standard drawer files. As soon as letters have been reviewed, the daily file is properly dated as well as checked and correspondence then filed in usual drawers. By having two of these expansible folders, one is always available for delayed correspondence, while the other is in use as a holder for daily letters.

Slag Macadam for Road Paving

IN London, Eng., experiments have been made in the use of tar slag macadam in several streets. The following report of the results as observed thus far is given by Municipal Engineering:

In St. Marylebone the material was laid in two coats and rolled, the surface being covered with fine granite chippings, and the total thickness when finished being 4½ inches. The price varied from 4s. to 4s. 8d. ($1 to $1.15) per yard super, and the paving is said to be wearing well.

The New Eltham and Sidcup road, trial length, was laid down in July, 1911, by the Kent County Council by arrangement with the road board. The material used was blast furnace slag ranging from 2¼ inches down to ¾ of an inch. When laid in one coat of mixed gages, the proportions are about 60 per cent. ranging from 2¼ inches down to 1¼ inches, 30 per cent. from 1¼ inches down to ¾ inch, 10 per cent. from ¾ inch down to ½ inch. The binder used is distilled tar, without any admixture of other material, and after first setting it is not affected by normal changes of temperature. The cost per yard super. was 3s. 3d. as paid to contractors, and the paving has stood well and is said to be satisfactory. Another section, 794½ super. yards, on the same road, laid with the same material, is also satisfactorily reported upon. The road board says:

"This section is quite good, and shows comparatively little wear. The roadway on both sides of this section is properly curbed and channeled; and has properly constructed footpaths. These abutments give considerable support to the material forming the carriageway, preventing lateral thrust, and enabling better initial consolidation."

In the borough of Wandsworth on the Portsmouth road, trial lengths were laid for the express purpose of making comparisons between the rates of wear of previously treated tarred granite when compared with similarly treated tarred slag macadam. A section of the latter—1,629.16 super. yards—was completed in August, 1911, coated slag being spread in two layers, first layer graded from 2½ inches down to 1½ inches, second layer from 1½ inches to ½ inch, surface finished with fine chippings. The cost per yard super. was 4s. ($1). The condition of this section is said to be good, and the surface wearing uniformly.

The New York State Highway Commission last year laid some sample slag pavements, some report of which is made by Division Engineer F. S. Strong in the official organ of the commission, from which the following is derived:

The types in which the use of slag is allowed include plain concrete pavements, concrete pavements with bituminous surfacing, Hassam concrete pavements, water-bound slag macadam with and without glutrin, some with limestone screenings and some with slag screenings, and bituminous-bound slag macadam highways. Much of this work is now under contract, and a considerable portion of it will be completed this year. The material is also being used to some little extent as a surfacing material in the repairing of old macadam pavements.

It is believed that the careful and continuous future inspection of the highways built of slag will produce valuable information and statistics of its merits as a road metal.

A big bulk of the slag available in the section of the state referred to consists of blast furnace slag. However, in the further reduction of pig iron in the production of steel, various processes are used, as, for instance, in the open-hearth furnace, where the crude metal is further purified, here again a flux is used which rises to the surface of the molten mass as slag. Slag formed in this operation has been used but very little on account of the small quantities available for highway purposes, although it possesses many desirable qualities, such as hardness, toughness and excellent cementing qualities.

In the vicinity of Youngstown, Ohio, in 1909, the office of public roads, in co-operation with the Carnegie Steel Company, conducted a series of experiments to determine the best method of utilizing this slag for road construction. In the experiments at this place, the blast furnace slag was taken from a bank that had aged about two years, the material of which came from six blast furnaces of the same type. A steam shovel was used to load the slag from the bank into large gondola cars. These cars were drawn to a gravity screen, where the slag was dumped into a chute and pased over the screen to separate into proper sizes. After passing over this screen, it was taken by rail to a site about 1½ miles from the road upon which it was to be used, unloaded and hauled to the road.

These experiments, as shown by the bulletins issued by the office of public roads, proved very interesting, and demonstrate that there is a field for blast furnace slag in the construction of highways, and the results were so favorable that the various counties and the State Highway Department of Ohio have adopted standard specifications for the use of this material. Various reports of inspections made of these roads show that they have stood up well, and, owing to the cheapness in the first cost of this material and the lightness in weight, the investment in a slag furnace macadam pavement from an economic standpoint would seem to compare favorably with that of a stone macadam pavement.

Since the completion of these experiments, which were conducted with slag which was not run through a crusher, but was taken directly from bank and screened, slag pavements have been constructed from commercial blast furnace slag, the slag being carefully sorted to obtain the best materials and run through a regular stone crusher in order to obtain the proper sizes for use in the various courses of macadam, resulting in superior types of construction and more uniform and lasting types of pavements.

In the vicinity of Buffalo, where there are many large blast furnaces, this slag has been used to some little extent for highway work, although no intelligent effort was made to obtain a high-class construction, due to the lack of available money for said purposes in the localities where the work was done. Yet this material is found to consolidate under traffic without rolling, harden and smooth out, making an excellent country road. Where incisions were made in some of these roads for various purposes, it was found almost as difficult to cut through this material as to cut through a concrete foundation for brick pavement.

At the beginning of 1913 a plant was established in connection with the Buffalo Union Iron Furnace to take over the slag product of these blast furnaces and produce therefrom a commercial product to be known as crushed screened slag for railroad ballasting and highway surfacing purposes. During the season of 1913 a considerable amount of this material was used on town highways, and reports received from various town and county superintendents in districts where this material was used stated that satisfactory results were obtained, although thus far it is too early to reach any conclusion as to the definite wearing qualities of this material.

In reference to the use of slag product in the open-hearth process in the manufacture of steel, perhaps some of the most successful work of this kind in the construction of streets or highways is that which has been done in the city of Cortland. In this city the first slag street was constructed ten years ago as a water-bound macadam highway, and, according to the city authorities, has given excellent results ever since. They also have other water-bound slag roads which have been built eight years with practically no repairs of any nature. During the last four or five years the city authorities have used a bituminous or asphaltic binder in the construction of the slag streets, using the penetration method with excellent results. The slag after being cooled is crushed in an ordinary stone crusher, the larger pieces being used in the bottom course, which is bound with loam. For the body of the top course, a slag varying in sizes from ¾ inch up to 2 inches is used. This top course has a finished depth of 3 inches, and is bound with a gallon to a gallon and a half of asphaltic binder to the square yard; is then filled with slag screenings and rolled. These streets have also the appearance of sheet asphalt pavements and are standing up well under fairly heavy traffic.

The authorities of the Toronto Observatory have been seeking an eligible site whereon to mount the giant reflector of 72-in. aperture now in course of construction. After much examination a suitable station has been found on a small hill 732 ft. high, about seven miles from Victoria. For air transparency the situation is admittedly inferior to the Lick Observatory, but it possesses some compensating advantages. The Government of British Columbia will assist the enterprise to the extent of purchasing the land—50 acres—and constructing a road to the top of the hill. The disc of the mirror is reported to be ready for shipment, and the constructors hope to erect the telescope next year.

A tunnel 14 miles long through the Caucasus Mountains has been proposed by a Russian committee. Through this tunnel, which will have great strategical value, the railroad between Waldikawkas and Tiflis will be shortened about 90 miles. The distance along the railroad is now 720 miles. The report states that the geological conditions are very favorable and that obstacles like those encountered at the Simplon tunnel are not to be expected. The temperature in the tunnel can be kept at 75 deg. Fahr. As the elevation of the tunnel is between 4,500 and 5,000 ft. above sea level no large subterranean flows of water will be encountered. From a geological point of view no reasons prevail why changes should be made in the proposed route. The work is estimated to require ten years to complete.

The proper amount of water to be used in mixing concrete is that amount which will produce a mixture of the specified consistency. The consistency of the mixture should be carefully watched, and not the dose of water.

Mainly Constructional

East and West—From Coast to Coast

EASTERN CANADA

Damage estimated at $10,000 was caused by a fire which occurred in the auditorium of a new $50,000 theatre at Brockville, Ont.

The Hamilton City Council has decided to submit a by-law authorizing the raising of $650,000 for laying storm overflow sewers.

At Chatham, Ont., a mill, dry kilns and boiler house belonging to the Sutherland Innes Company, have been destroyed by fire. The extent of the loss is not known.

The Hawkesbury Board and Paper Mills have in contemplation the construction of a paper and board mill at Hawkesbury, Ont. It is not anticipated that the erection of the building will take place this year.

At Halifax, N.S., a business block on the corner of Burlington, Argyle and Sackville streets, has been destroyed by fire. The stone front is reported to have been destroyed and the loss is estimated at $125,000.

Essex Motor Cycle & Machine Company, Limited, has been incorporated with head office at Essex, Ont., and a capital of $100,000. The new company will engage in the manufacture of motors and motor cycles.

The new drill hall in course of construction on St. Louis Street, Quebec, for the Dominion Government, is nearing completion. The building is stone construction and will cost about $150,000. Mr. D. Ewart, Ottawa, is the architect.

The parish of St. Anne de la Pocatiere, Que., is erecting a college of stone, terra cotta and reinforced concrete construction, at a cost of $400,000. Already the walls have been erected and work is being pushed as rapidly as possible.

The plant of the Canadian Metal Products, Limited, Guelph, Ont., is at present working at capacity. The company are said to have secured a share of the present boom in that line of business and the prospects for a good year are very bright.

A report comes from Windsor, Ont,, that government contracts aggregating about half a million dollars have been closed with manufacturers of Windsor, Walkerville and Sandwich for war supplies, including automobiles, ammunition, motor trucks, etc.

The first definite proposition for the erection of houses under the new Housing Law, has been made to the St. John, N.B., City Council by Mr. Arthur H. Likely, who owns a large building tract at East St. John. He proposes to organize a company to build 500 workmen's houses.

At St. John, N.B., the new post office which the Dominion Government is erecting on Prince William Street at a cost of $500,000, is rapidly nearing completion. Mr. G. E. Fairweather, St. John, is the architect, and Messrs. Rhodes Curry Company, Amherst, N. S., are the general contractors.

A Machinery Hall, estimated to cost $145,000, is to be erected at the Exhibition Grounds, Toronto, according to plans prepared by Mr. G. W. Gouinlock. The building is to be of concrete, steel and brick construction. Tenders are to be called shortly with a view to starting the work this fall.

The Gilson Manufacturing Company, Limited, Guelph, Ont., has received an order for several hundred gasoline engines. These engines, ranging from 2 to 8 h.p., will be used for operating concrete mixers, hoists, etc. The order is said to have been obtained from the largest manufacturers of concrete machinery in the world.

The International Engineering Works, Toronto, have been awarded the contract for four Continental type Robb Scotch boilers of 250 h.p., for installation in connection with the filtration plant extension at Toronto Island, the general contractors for which are the John ver Mehr Engineering Company and Wm. Cowlin & Sons, both of Toronto.

At Toronto, Ont., the Advisory Industrial Committee has passed an appropriation of $25,000 to be used for the purchase of engines, generators and other machinery in connection with the equipment of the new Technical School. A request will be made to the Board of Control for the necessary funds and it is said that the purchase of Canadian-made machinery will be effected as far as possible.

One of the most extensive jobs being carried out in Montreal is the construction of underground conduits in the down-town section of the city. The work is being hurried forward by Mr. G. M. Gest, the contractor for the city. The laying of the lighting, power and other cables and the connection of these with the various offices, stores, and houses will be made next spring.

The Department of Railways and Canals and the municipalities which use the Welland Canal as a source of water supply have entered into an agreement by which the government proposes to construct a pipe line from Lake Erie to supply reservoirs of towns. The offer of the municipalities of St. Catharines, Welland, Thorald and Merritton to pay jointly an annual rental of $10,000 per year for thirty years, has been accepted. The work, which will cost over a million dollars, will be undertaken by the Government.

At Hamilton, work is in progress on a soap factory, estimated to cost $1,000,000, for Messrs. Proctor & Gamble Company. The buildings are to be of reinforced concrete, hol-Hamilton has been awarded to Messrs. Stone & Webster Company, of Boston. Contracts for the steel work were awarded some time ago to the Hamilton Bridge Company. It is said that all sub-contracts will be awarded in Canada and that Canadian goods and Canadian workmen will be given preference throughout. The new building will be twelve storeys high and contain 250 rooms. The total expenditure involved is $1,000,000.

Several large steel bridges are now under construction in New Brunswick. The spandrel arch bridge at St. John, which bridges the Reversing Falls, and which will be utilized for street-car and general traffic, is well advanced. The east and west spans have been united in the centre, and the remainder of the work will be completed in time for use next spring. The new steel bridge, which the provincial government is constructing at Grand Falls, is almost completed, and in a few days the finishing touches will have been made to the new bridge which crosses the Miramichi River at Newcastle. In addition to these structures two large steel bridges for the use of the Valley Railway are in contemplation. The C. P. R. also has under consideration the building of a new cantilever bridge, of a somewhat different type from that now used by the railway at the Falls, St. John.

WESTERN CANADA

At Victoria, B.C., extensions to the post office are being carried out at a cost of $150,000. The general contractors are the McAlpine, Robertson Construction Company, Vancouver.

The Winnipeg City Council has succeeded in obtaining a loan of $2,000,000 for continuing the Shoal Lake water scheme. It is said that the work will now proceed without cessation for at least another year.

The Dominion Government is constructing a reinforced concrete grain elevator at Vancouver, B.C. Bids for the contract will be received by the Department of Trade and Commerce, Ottawa, up to November 13.

The new $50,000 addition to the Dominion Government building at New Westminster, B.C., is practically completed. It is anticipated that the various office staffs will be in occupation of the new building in the immediate future.

Work on the Government Immigration building at Vancouver, B.C., is now under weigh. The structure is to be five-storey, 220 x 64, brick and steel, and is estimated to cost $350,000. Messrs. Geo. Snider & Brethour are the general contractors.

In the October 14 issue of the Contract Record it was erroneously reported, on page 1282, that the fire losses at Saskatoon during the month of August last amounted to rather more than three million dollars. The actual figures were $3,037.50.

The contract has been let to Mr. J. W. Pike, of Vancouver, for the construction of an 8-ft. dyke and 20-ft. ditch at Richmond, B.C. The work will involve an expenditure of about $26,000. The object is to prevent periodical floodings of this district.

The exterior work on the new armoury which is being erected at Winnipeg for the Dominion Government, at a cost of more than half a million dollars, is nearing completion. The general contractors are Messrs. Carter-Halls-Aldinger Company, Winnipeg.

At Vancouver, B.C., the Union Steamship Company has made an offer to the civic bridges and railways committee to construct a bridge over the C. P. R. tracks at the foot of Carrall street, on plans approved by the committee, and the company has been requested to furnish plans for approval.

The new marine railway dry dock constructed by the Dominion Government at Selkirk, Man., has been formally opened. The new dock will be capable of accommodating boats up to 1,500 tons capacity. The Crandall Engineering Company were the contractors and Mr. Sweeney, District Engineer.

Members of the Regina Engineering Society visited Moose Jaw recently on the invitation of the City Commissioners. The company, which included Mr. R. O. Wynne-Roberts, Consulting Engineer, Regina, made an inspection of the principal civic works, and were also entertained at luncheon in the Royal George Hotel.

The Calgary Branch of the Canadian Society of Civil Engineers entertained the engineers in attendance at the recent International Irrigation Congress. Mr. H. B. Muckleston, Assistant Engineer, Department of Natural Resources, C. P. R., and chairman of the branch, presided, and several interesting addresses were delivered during the evening.

The Dominion Construction Company, Vancouver, have been awarded the contract for the erection of an addition to the provincial court house building, the contract price being $56,000. The plans call for a three-storey structure to face on Clarkson Street and connect with the present building. Actual construction work will begin without delay. Messrs. Gardiner & Mercer are the architects.

At New Westminster, B.C., pile driving has been started at the waterfront in connection with a new building to be erected for Mr. Jos. Meyers. The structure will comprise coal bunkers, storage sheds and office, 132 x 115 feet. The total cost will be about $8,000. Plans for the superstructure are being prepared by Messrs. Gardiner & Mercer, architects. The Fraser River Pile Driving Company have the contract for the pile driving.

It is announced that practically half the main line of the Canadian Pacific Railway between Fort William and Vancouver is now double-tracked. Mr. J. G. Sullivan, Chief Engineer of the company, has stated that 350 miles of double-tracking has been completed this year between Brandon and the Pacific Coast. Prior to this year the road had been double-tracked between Fort William and Brandon, a distance of 559 miles, making a total of 909 miles completed to date.

Personal Mention

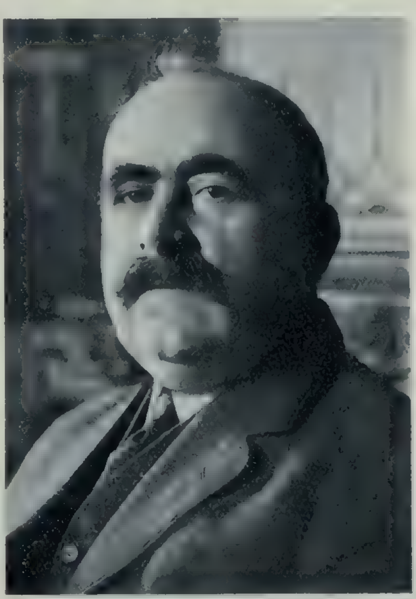
Hon. Colin H. Campbell, former Attorney-General and later Minister of Public Works in the Manitoba Cabinet, died a few days ago at his home in Winnipeg.

Mr. F. W. Thorold, Toronto, has been appointed Consulting Engineer to the Board of Water Commissioners, Port Hope, in connection with the installation of a complete system of water filtration. Tenders are now being called for the intake.

Mr. R. C. Mission, sales manager, eastern division of the Sherwin-Williams Company of Canada, Limited, has been appointed manager of the eastern division with headquarters at Montreal. Mr. Mission has been connected with the Sherwin-Williams company since its inception in 1895, his first position being that of travelling representative in Eastern Canada.

John F. Connolly, Contractor

Mr. John F. Connolly, President of the Connolly-Agnew Construction Company, general contractors, Toronto, was born in 1864. Educated at the Jacques Cartier Model School, Catholic High School and Victoria College, he became an accountant with Messrs. J. D. Adams & Company, Montreal, in 1892. Five years later he was agent at Montreal for the Allan Steamship Line. He became identified with contracting work in 1889, being partner in the firm of Clarke & Connolly. In 1899 Mr.Connolly entered the contracting business on his own account, and founded the present company on January 1, 1914. During his career he has carried out many important constructional undertakings, of which a few are sewerage systems at Prescott, Cornwall, Smiths Falls, Gananoque, St. Thomas, Ont., and Newcastle, N.B. He also built some sections of trunk sewers at Toronto, Sault Ste. Marie, Ont., and Winnipeg, and constructed waterworks systems at Steelton, Midland, Arnprior, Port Elgin, Mt. Forest, St. Marys, Owen Sound, Amherst, N.S., and Richelieu, Que. Other works carried out by Mr. Connolly include the construction of 36 x 42-inch mains at Toronto, sewage disposal works, sewerage and water systems at Bowmanville, Weston, Ont., and other centres. His favorite recreations are curling, angling and bridge.


Mr. John F. Connolly.

Mr. O. W. Smith, A. M., Can. Soc. C. E., who is the contributor of an article in this issue of the Contract Record, is a native of Nova Scotia, having been born at Port Williams, King's County, in 1876. He was educated at the Windsor Collegiate School, matriculating into King's College, Windsor, in 1893. He entered the Civil Engineering Course and four years later obtained the degree of Bachelor of Engineering. During the next two years he was engaged as instrument man on the location of the Crow's Nest Pass Railway. From 1899 to 1902 he was construction engineer of the Inverness and Richmond railway and the Cape Breton railway. From 1902 to 1904 he filled the position of engineer in charge of sewage works at Wolfville and Amherst, N. S. From 1904 to 1906 he was in charge of the Regina water and sewage works and the year following saw him in charge of design and construction of electric lighting, sewage and waterworks at Indian Head. During the years of 1907-1910 he was a member of the firm of Galt & Smith, civil and sanitary engineers, Toronto. Since 1910 Mr. Smith has been a consulting and contracting engineer at Regina, Sask.

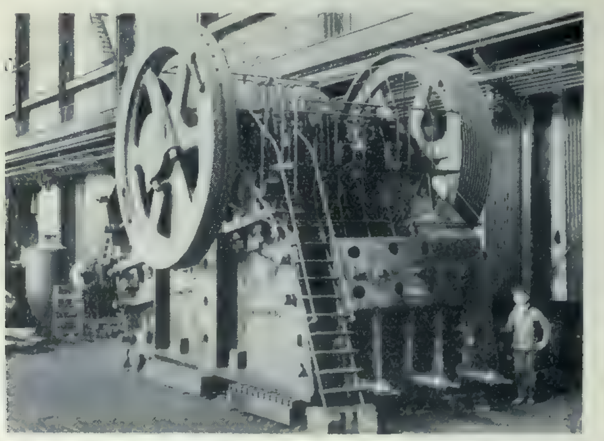
Mr. W. N. Ashplant, City Engineer, London, Ont., has offered his services with the second army contingent. Mr. 7th Fusiliers of London, Ont.

Mr. R. A. Campbell has resigned his position as superintendent of the Tagona Water & Lake Company, Sault Ste. Marie. His successor is Mr. R. D. S. Buckstedt.

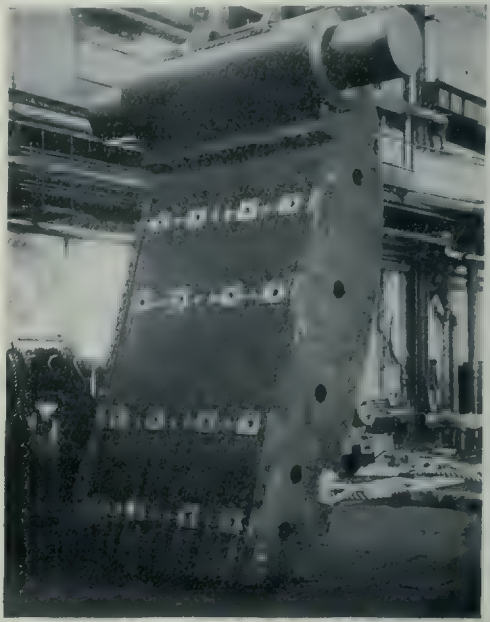
Professor E. Brydone-Jack presided over the inaugural meeting of the Manitoba Branch of the Canadian Society of Civil Engineers, which was held, October 8, at Winnipeg. Mr. W. G. Chace, Chief Engineer of the Greater Winnipeg Water District, addressed the meeting on some important features of the Shoal Lake water project.

A Large Rock Crusher

A rock crusher, of the jaw type, recently built by Allis-Chalmers Manufacturing Company, is of an unusual size and capacity. The overall dimensions are, length 29 ft. 9¾ in., breadth, 16 ft. 5 13-16 in., and height 17 ft. 3 in., and the approximate weight is 510,000 lbs. The frame is made of cast steel, the ends being of the hollow box section type with internal ribs, and the sides of ribbed section. Liberal dimensions were used throughout. The pitman is made of cast steel of extra strong box section and is fitted with a removable cap which facilitates handling and makes it unnecessary to take out the entire pitman to re-babbitt the eccentric bearing in the cap. The pitman is provided with large grease cups for lubrication, and arrangements are also made for oil lubrication by means of a continuous pressure system. The eccentric or pitman shaft is made of the best quality forged steel, heat treated, 20 in. x 24 in., finished diameter, with the eccentric key forged on. The swing jaw shaft is also made of the best quality forged steel 21 in. diameter. The swing jaw weighs 70,000 lbs. without the jaw plates. It is made of cast steel, bored for the swinging shaft, and machined on the face for the receiving jaw plates and on the back for toggle seats. The cast iron flywheels are each 12 ft. in diameter. The crusher has a receiving opening 66 in. x 84 in. In operation the machine produces about 300 tons an hour with a maximum opening of 4⅞ in. between the jaws, but if the machine were opened up to 6-in. the capacity would be increased about 20 per cent. From 200 h.p. to 250 h.p. is required to operate it, depending on the character of the stone.



66 in. x 84 in. Allis-Chalmers Jaw Crusher.



Swing jaw, with jaw plates removed, of Allis-Chalmers crusher.

Book Reviews

Cast Iron and Steel Pipes. By John Sharp (New York; Messrs. Longmans, Green & Company). The author of this book, which cannot fail to be received with much interest by engineers and contractors, has had extended experience in this field and shows an expert knowledge of the subject in the observations and formulae which he adduces. The book covers all the important phases, special attention being devoted to tests and to corrosion. The author enters into an examination of "some of the more outstanding chemical and physical conditions which contribute to the comparative success or failure of either quality of pipe and which it is the desire of all engineers and other authorities to anticipate in the interest of the communities by whom they are appointed." The value of the work is enhanced by tables and diagrams.

The Link-Belt Company, Chicago, Ill., have just issued their new locomotive book, No. 158, which shows the possibilities of this equipment in regard to the efficient and expeditious handling of material. In the one machine there is combined a portable hoisting engine, swinging derrick, grab bucket unloader and switch engine. The cranes are adapted to a wide range of service and conditions. Their applications are well illustrated in the booklet.

The substructure of a bridge for the Intercolonial Railway over the Nashwaak River, N.B., consisting of two abutments and four piers, has been completed by Messrs. Baird & Howie, contractors, Fredericton, N.B. Foundation work involving some difficulty was encountered, one of the piers reaching 30 ft. below water level, while below this again excavation to bedrock was necessary. The greater proportion of the concrete work on the piers and abutments was run last winter under severe weather conditions, with no detrimental effect. The substructure will cost about $45,000.

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Alphabetical Index of Advertisers
Page 18

Vol. 28 November 11, 1914 No. 45

Principal Contents

Page
The Building Owner as a Gambler 1365
Engineering Topics in the Old Land 1366
Special London, Eng., Correspondence of the Contract Record
County and Municipal Engineering 1367
Pumping Plants on Dyked Lands in British Columbia 1368
By W. Poole Dryer
Electrical vs. Steam Pumping 1369-71
C. N. R. Bridge Work at Calgary 1371-2
A Discussion of the Relative Values of Paving Material 1373-6
The Brick Road and Its Construction 1376-7
By Jas. McCleary
Transcontinental Railway Company's Air-Lift Plant at New Quebec Bridge 1377
Features of Recent Additions to the Canada Cement Company's Plant at Exshaw, Alta. 1378-9
Standards for the Turbidity of Water 1379
Difficulties Encountered in Building a Reinforced Concrete Aqueduct 17 feet in Diameter 1380-1
By George T. Seabury
Points of Interest in New Electrolytic Sewage Treatment 1382-3
Pumping Water by Compressed Air 1383-4
By Geo. C. Thompson
Injection of Cement Grout Into Water-Bearing Fissures 1385-6
By Francis Donaldson
Wind Stress on Roofs 1386-7
By G. D. Mills
Concrete "Lumber" for Mine Shafts 1387-8
A New Type of Creosoting Plant 1389
Personal Mention 1390
Constructional News 1390-2

The Building Owner as a Gambler

In view of the falling off in constructional activity it may appear ill-timed to refer to the gambling propensities of the building-owner, but in reality, in our opinion at any rate, there could not be a better time to take up such questions, as it is during the lull in construction that contractors are enabled to sound their depths.

The rank uncertainty of the present method of estimating continues to occupy the attention of the architectural and building fraternity and of those owners who do not seek to beat the contractor and material men. Referring to the lamentable conditions existing, a correspondent of "The Quantity Surveyor," when voicing his opinions in reference to certain owners' well-known attitude of "heads I win, tails you lose," thinks this is the fundamental difficulty we have to contend with.

It certainly seems difficult to demonstrate to some owners how a straight and accurate bill of quantities to estimate upon helps them to get better work, a square deal, and a satisfied contractor. It is the experience of those who have long been engaged in the practical advocacy of the quantity system to find that, although the average owner will strenuously deny trying to get "something for nothing" out of a contractor, they, for the most part, really do this very thing. They will hire a certain type of architect, not altogether for his talent as an artist, but for the purpose of helping them get the best of the contractor. This is attempted robbery, from whichever way we may look at it. Can we wonder if, in self-protection, the contractor retaliates?

Such owners appear to argue in their own minds something like this: "I (the owner), holding a pack of marked cards, to be used after a contract is signed, must first put a number of bidders to work "gambling" with each other to see who shall have the privilege (?) of playing with me in the final. My standing in the community must be taken by the winner as a sufficient assurance that we two, when we play, will play a square game, whatever the previous players may have done between themselves. I (the owner) know something of the building business, and doubt if this contractor fellow knows enough to get ahead of me and my architect, and he surely will not think to keep a few cards up his sleeve! Even if he does, he cannot always select the right cards, because he will forget that I am already fixed so as to take most of the tricks any way, and so the game will be played almost as I direct. Suppose by chance my tricks are trumped too often and I am likely to lose Is not the referee under the contract in my employ? What do I pay him for? He must protect me, for am I not the owner? I must not let my adversary win, notwithstanding his money is invested in my building and regardless of his practical knowledge, which must also be used to my advantage. Besides, I do not have to play the game every day. The next time I do I will look out for a different man—one belonging to my fraternity, one just starting in business and anxious to please preferred."

And this is how the building game is too often played. Common custom and convention compels a certain type among the unprivileged class of architects (those who are not altogether financially independent of clients) to follow those methods which lead to possible future business. That is but human nature, and the human element of self-interest is more often than not apparent. But if a clear detailed bill of quantities is once made the basis of the contract—i.e., so much labor and material for so much money and no more (and no less)—then it will help to relieve the other and better type of architects, who do try to be fair to both contractor and owner, from embarrassing positions and decisions, and from otherwise acting in judicial capacities under building contracts, and which often accounts for the loss to them of business friends and ultimate loss of professional practice.

Engineering Topics In The Old Land

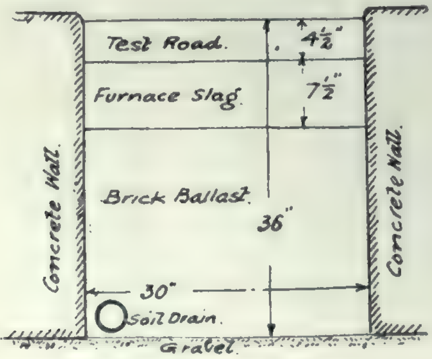
An Interesting Action Involving Road Work—Road Tests—The German "Siege Gun Platforms"—Competitive Appointments

By the London, Eng., Correspondent of the Contract Record

An action of considerable interest to local authorities and of the greatest possible interest to at least one firm of manufacturers is in progress at the High Courts of Justice. The Gas, Light and Coke Company ask for injunctions to restrain the Woodford and the Wanstead Urban District Councils from repairing roads in their districts with reinforced concrete. The reason of the action is obvious. Gas companies will have not only to go to additional expense in opening a road but to further additional expense in making good again. The steel reinforcement has to be cut away when opening a trench, and if the reinforcing properties are to remain effective the greatest care must be taken in reinstating the continuity of the new and the old work. The difficulty of this has been anticipated by the makers, and the system of repair is ingenious; but what was not anticipated was this trouble with the companies that have the legal right to open public roads. To place the whole additional burden upon their shoulders seems perhaps scarcely fair, and doubtless some middle course will be decided upon.

Water-Bound Macadam Road Test

Reference has been made in this paper to the Road Board Laboratory which has been established at the National Physical Laboratory for the purpose of testing road stones. Actual road sections are here subjected to artificial wear by means of the action of steel wheels variously loaded, while an attempt is made to impose certain weather conditions upon the surface. In the report of the Laboratory for the year 1913-14, the results of tests made during the year are given. One of these tests was that of a water-bound macadam road. The road (2 ft. 6 ins. wide) was built up as indicated in the sketch; 2 ft. of brick ballast was filled in on top of the gravel base and well rammed, the bottom of the ballast being drained with soil drains. Next followed 7½ ins. of furnace slag, watered, and well rammed in two layers, the interstices being filled in with hoggin. The test road proper, 4½ ins. thick, was made of granite (Penlee) stone shovelled in, well rammed and rolled. It was made in four sections:— (a) 2¼ ins. stone; (b) 2¼ to ¾ in. stone; (c 1½ ins. stone; (d crusher run. A test was then made on the central 24 ins. of the track by subjecting it to the action of the 8 steel wheels, each 3 ins. in width, the total load on each wheel being 800 lbs. Longitudinal and cross sections of the road were taken mechanically in order to obtain the amount of deformation of the surface and to study the production of hollows and ridges. After enduring 3,000 tons per yard width the surface of the track was so broken up that the test was discontinued.



Water-bound macadam test road.

Tar Macadam Road Test

In the case of the next test, the previous road was dug out, leaving 20½ ins. of brick ballast; upon this was laid 7 inches of binding gravel, which was well rammed. The remainder of the foundation was made to a specification prepared by Colonel Crompton, with 4 inches of blast furnace slag in two layers, each layer being rammed with pitch grout. A tarmac road was then laid on this foundation in two layers, one 2½ ins. thick and the other 1½ ins., each layer being well rolled, and tarred chips being sprinkled over to fill the interstices. The total weight on each wheel in the test was 1,400 lbs. and during the first 20 minutes considerable lowering of the level, amounting to about ¼ inch, took place and was probably due to consolidation of the material. As the test proceeded it was found that there was a tendency for the material of the track which was not subjected to the action of the wheels to be forced upwards by the action of the inner and outer wheels, which on this account sank lower than those at the centre. It appeared, therefore, that this test did not give an accurate measure of the endurance of the track, although valuable information on the formation of waves was obtained. After 36,750 tons per yard width the mean deformation was 0.64 ins., and the rate after 11,200 tons per yard width was about .0041 inches for 1,000 tons per yard width. The result of these tests must be received with caution and reserve. They may be regarded as what would happen to similar forms of construction under ordinary and practical conditions of wear and tear; but they may just as well be regarded merely as what does happen under the Road Board test, which is quite a different thing. Everyone knows that tar-macadam outwears water-bound macadam, and that is as far as one can with safety go at present. There were other tests made with roadways formed in accordance with the Road Board specification, but it is obvious that these lose their value as they were made by the Board itself. It is a case of special pleading.

Siege Gun Platforms

Quite a crop of siege gun platforms have been raised in London during the past few weeks. The most important "find" was at Acton where, it was alleged, a German firm had built a one-storey factory with a concrete roof having a thickness of no less than four feet. Later intelligence reduced this to three feet, and calculated inspection finally settled that it was under one foot thick and built in reinforced concrete. As the factory was in use as a printing works, where a large quantity of paper was stored, the thickness of the roof—which, it was allowed, was ultimately to serve as a floor (when further storeys had been added)—was not excessive. Had the journalists who reported this case had any technical knowledge, they would have recognized from the first that they were on a mare's nest. To commence with, a four-foot concrete roof on a one-storey building would have created a sensation when it was put up some years ago. Then, again, it is not customary to use a floor for the support of the upper storeys of a building. Walls are built on walls, and unless the walls of this building were buttressed and built in the most substantial manner, and well tied together (by something more than a concrete roof) the kick of the first shot fired from a German siege gun would have brought the whole building to the ground.

Professional Bids

The Eastern Valleys (Monmouthshire) Joint Sewerage Board invite applications for the position of engineer to the board, to advise them as to the preparation of a sewerage scheme and other works. Applications (runs the advertisement) are to state qualifications and terms required, which means, in plain language, that engineers are to tender for the work. Now this places the engineer in a very difficult position. Naturally, he wants the work. Things are very bad in Westminster through the war, and the shutters will have to be put up in more offices than one. But the rules of the Institution of Civil Engineers prohibit touting and advertising, and the man who tenders for this job runs the risk of reprimand, if not of compulsory resignation. Etiquette alone would perhaps prevent engineers from entering a competition of this kind, did not the necessity for earning a living intervene. The proper course in a case such as this (the writer has it on high authority) is for the local body to approach the president of the institution, asking him to appoint an engineer. Competition would then be avoided, and the circle of satellites which revolve around the presidential chair would again come into what is called "their own." The profession is however growing restive, and developments of a revolutionary nature may mark the next few years. To him who hath shall not be given for ever, and there will be keen competition over this Monmouthshire job.

According to reports received in Ottawa from Mr. F. A. C. Bikerdike, Canadian Trade Commissioner, Manchester, Eng., Canadian manufacturers have now the opportunity to supply Great Britain with the following products owing to the discontinuance of imports of iron and steel manufactured articles from Germany:—Wire nails, cut nails, nuts and bolts, machine screws, barbed wire, and domestic wire goods.

About 65 per cent. of the permanent way of the Swiss Federal Railways are equipped with steel sleepers. The weight of the sleepers is 25.16 kilos. per running meter, and when the holes for the rail attachments are complete they weigh 72.5 kilos. (159.8 lbs.) each. The tensile stress specified is from 35 kilos. to 45 kilos. per square millimetre, and the entire trough piece must be capable of being bent back double without showing any crack. At the switches double-trough sleepers are used, which weigh 125 kilos. (275.5 lbs.) each.

County and Municipal Engineering

THE field of county and municipal engineering offers no inducements to the seeker of wealth. The engineer of brilliant intellect that seeks to conquer mountains and bridge untamed rivers and expects to reap rewards commensurate with his ability had best seek some other field for the utilization of his gifts. But to the man of sound judgment and moderate but well balanced attainments in the details of the work of a civil engineer the field of county and municipal engineering has always proved attractive and will become more so in the future.

The welfare of the modern city and the modern countryside is yearly becoming more dependent upon those structural works which it is the province of civil engineers to construct and maintain. Moreover the proper administration of civic affairs requires such a detailed knowledge of these mechanical features that a public official is no better fitted for their oversight than by the training received by a civil engineer. That the public is realizing this fact is well illustrated in the appointment of many civil engineers to positions as city managers, county road superintendents and city and county engineers.

The salaries attached to such positions have always been low and will probably always remain low. But the number of openings is steadily increasing and the certainty of continuous employment is perhaps on a firmer basis than in any other branch of civil engineering. A field for service as operating engineers for structural works is developing. Examples of the positions in this field are those of county engineers and road superintendents, waterworks superintendents and sewage plant superintendents.

Civil service and the commission form of government are factors that have contributed toward eliminating much of the uncertainty of employment that heretofore has been the chief objection to such work. And yet with its uncertainty the engineering work of cities and counties must be performed regardless of wars and financial conditions and the engineer well versed in the details of such work has no real excuse for being idle.

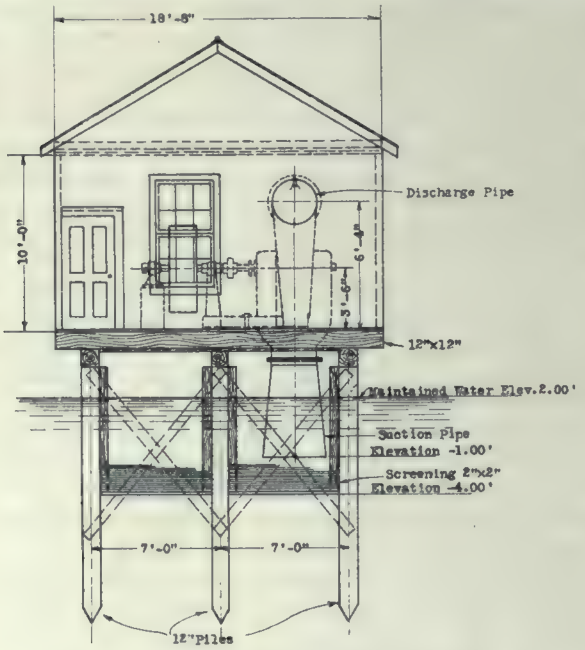
The field is, however, for the general practitioner rather than the specialist. More than mere technical proficiency is required. Tact, executive ability and a disposition to remain contented in one position are also necessary. The duties of men employed in this field while broad in their scope and demanding ingenuity and the ability to use funds—frequently insufficient funds—to the best advantage, are comparatively simple and routine from an engineering standpoint. For this reason, perhaps, salaries are low.

For the engineer that takes pleasure in designing engineering structures and working out his designs on the ground in person, for the engineer that delights in the organization of construction work and the trying out of his individual ideas, for the engineer that is content to work for a moderate salary, county and municipal engineering offers attractions. But for the man that commercializes his ability and demands adequate financial return the field offers few inducements. —Engineering and Contracting.

Pumping Plants on Dyked Lands in British Columbia

Contributed by W. Poole Dryer, Vancouver, B.C.

IN British Columbia, where rugged mountains monopolize so much of the area, the valleys and the flat lands are in great demand for the uses of agriculture. Along the estuary of that great waterway of the province, the Fraser River, there lie extensive deltas silted up for ages with deep alluvial soil. Although these flats are unusually fertile the cultivation of them is not possible without dyking, as every year they would be inundated by floods. Of this rich land 43,126 acres have been reclaimed; earth dykes have been built, large pumping plants installed; so that now there are living on it hundreds of prosperous settlers. In Vancouver, twenty to forty miles distant from all sections, a nearby market is provided.



Front end elevation of pump house at Maple Ridge.

Although the land is privately owned, its reclamation is financed and administered by the provincial government. To look after this work a Department of Dykes was formed and placed under the superintendency of Mr. E. A. Wilmot. The initial cost of reclamation was met by the sale of 40-year 5 per cent. bonds. All annual expenditure for pumps and administration is defrayed by an acreage tax. This tax is levied upon separate districts according to the expenditure actually incurred in each, for by its topography the land naturally divides into six districts ranging in area from 1,125 to 19,000 acres.

Round each district is a dyke, following along the riverside and running into the higher ground inland. The first dykes were built twenty years ago, and since then others have been added. Steam-driven pumping plants were erected, but in time these proved to give insufficient drainage and were very costly to operate. In 1912, however, the government, realizing the desirability of increasing the settlement, decided to do so by improving the drainage, that the soil by being kept drier would be made fully productive. This entailed the electrification of the old steam-driven plants, and the building of new electric pumping stations. The additional outlay of money involved had to be carefully considered so as to prevent imposing a heavy burden on the settlers; for it should be borne in mind that the ultimate financial success of reclamation and of irrigation schemes depends to a large extent upon low pumping charges. In the work outlined here great care was taken to select pumping machinery which could be operated at a minimum cost, and which had features specially fitted for the conditions. These features, which have proved in the last season's pumping to be conducive to economy, are described further on in detail.

Dykes and Ditches

Ramifying throughout the flats of each district are large drainage ditches, which feed into a main ditch running alongside one dyke—the dyke, in fact, is formed of the earth raised in excavating the ditch. On the Fraser River this ditch is located between the dyke and the river, for with the ditch on the inner side of the dyke (as in the earlier Pitt River reclamations). the seepage through the dyke into the ditch is very considerable.

Here and there along the dykes a cut is made in which is placed a large flap gate. Through these gates the main ditch empties into the river. Thus the land is drained eight months in the year. the river level being lower during that period. But with the melting of the snows on the mountains in the interior the swollen rivers rise from ten to fifteen feet. This rise, beginning in May, is maintained throughout the four summer months. The problem to be dealt with then is the drainage of the land lying at a lower level than the river—the flap gates have shut back and drainage by gravity has become impossible.

The pumping plants have then to be started running, and by their operation night and day all summer the districts enclosed by the dykes are drained. The water is drawn by the pump from the main ditch and is conveyed into the river by means of a discharge pipe passing through the dyke.

Some idea of the large volume of water to be pumped off the Maple Ridge district may be formed by considering that, on its area of 8,400 acres, the monthly rainfall of 5.6 inches—as in June, 1913—is equivalent to 42,000 000 gallons per day. In addition to this precipitation there is the water coming from the higher lands behind the dyked area, and there is also considerable seepage through the dyke from the river into the ditch; these two additions, however, are offset more or less by the general evaporation from the land.

In pumping such a large volume it will readily be seen that a burdensome expenditure will be incurred unless cheap power is available, and unless care is taken to select economical pumping apparatus.

Electrical vs. Steam Pumping

For twenty years pumping was done by steam power but the high cost of coal prevented as much pumping being carried on as was required to keep the land in the best condition. Electrification was not feasible until two years ago when the transmission lines of the Western Canada Power Company, leading to Vancouver, were constructed near the dyked lands.

With the advent of this cheap hydro-electric energy a new epoch opened up in the cultivation of these reclaimed lands. The dyking authorities immediately grasped the opportunity of utilizing this source of power greatly to improve the fertility of the soil. At the old expenditure incurred by steam power, double the pumping could now be done, the water in the ditches lowered by two feet, and the sogginess—with the resulting sourness—eliminated from the soil. The four old steam pumps were therefore electrified, and five new electrical pumping plants built. On these lands administered by the government there are installed 1,050 h.p. of motors on pumping duty. The economy resulting from the abandonment of the use of coal has proved most gratifying. The relative cost of operation may be compared in the Matsqui Stations, where two 200-h.p. motors now operate the old steam-driven pumps. The following table gives the cost actually incurred in the same stations, with approximately the same pumping results:

	1911 steam operation	1912 electrical operation
Cost of wages	$2,149	$ 807
Cost of coal	2,545	......
Cost of electric power	......	1,039
Cost of supplies and maintenance	211	144
Total cost of operation	$4.905	$1,990
Number of hours pumping	1,413	1,107
Cost of pumping per hour	$3.47	$1.80

These figures, moveover, do not put the best complexion on the results of the electrification, for the interest on capital cost is now much lower than with the steam-driven plants; with the latter there is the engine and the boiler, as compared with only the motor in the new installations.

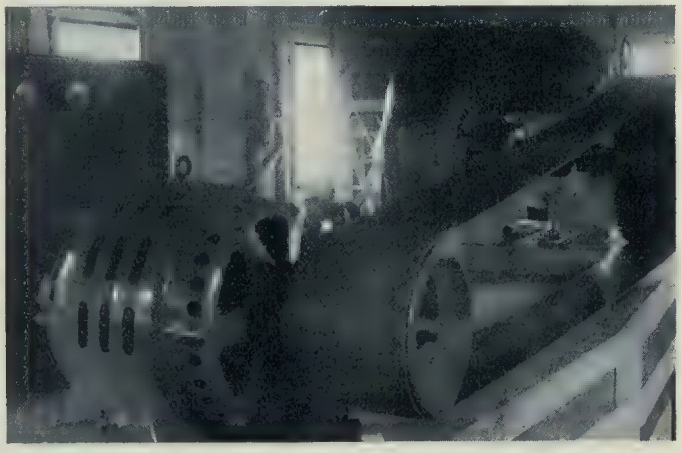
The success of this electrification is in no small measure the result of the effective manner in which the Power Company co-operated with the dyking authorities. It entered into a contract to supply the provincial government with cheap energy for all the reclamation stations, lending its engineers for supervising the alterations and for advising in the selection of the new machinery. Acting for the Western Canada Power Company, Mr. J. F. Cahan, their construction engineer, designed and personally superintended the building of these plants.

As an important element governing the design of the pumping stations, it should be mentioned that these have all been arranged so that the unskilled sons of the ranchers can safely operate them. This condition dictated the choice of apparatus which would be reliable and be automatically safeguarded to the highest degree.

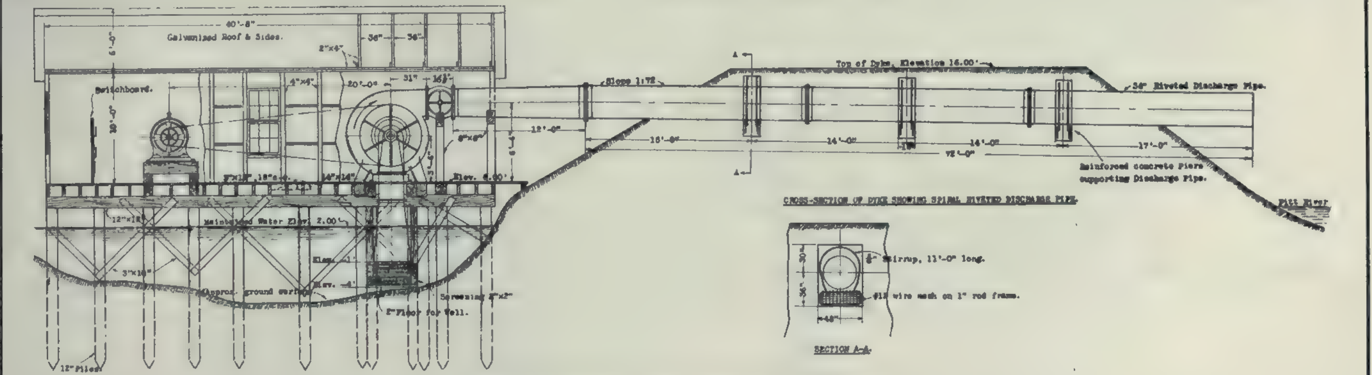
Pumps—Construction

The commercial success of reclamation and irrigation schemes like this depends to a large extent on economical pumping, and this, in turn, is determined by the selection of suitable machinery. The pumps must be carefully designed so as to be highly efficient. As excellent results have been obtained by the large pumps installed on the dykes this year, it will be of interest to call attention to the outstanding features of their construction and performance.

These pumps were obtained from The W. Poole Dryer Company, Limited, Engineers, of Vancouver and Glasgow, who had been engaged on the electrification of all the old steam stations, and were familiar with the pumping conditions. This firm had the pumps manufactured to the most modern designs by Messrs. Gwynnes, Limited, of London, England. Each of the pumps has a capacity of 30,000 U. S. gallons per minute, the head varying from 6 to 12 feet. Both the discharge and the suction openings are of 30-in. diameter. The drive is by means of a 16-in. belt from an electric motor. Although a certain loss necessarily results from the belting, still, with this arrangement, the overall economy is greater in this instance than would be with a direct drive, which for low heads demands a compromise between the best inherent speeds of the pump and the motor. In other words, a pump for a low head should for best efficiency run at a speed which is so slow that a motor designed for it would be very large and expensive.


Maple Ridge pumping station 100 h.p. motor—3 phase, 2,300 volts. 30,000-gal. Gwynne pump.

It will be seen from the illustration that the pump



Sectional elevation, pump house at Maple Ridge.

casing is constructed so as to allow suction pipe arrangements of the simplest nature. One single large pipe suffices, and it is located directly under the centre of the pump, the compactness showing itself both above the floor and in the small size required for the intake well. Inside the pump casing the suction passage divides, so as to give a balanced flow on to both sides of the impeller.

A handy feature of the construction is that the casing is arranged so that the impeller can be withdrawn sidewise without disturbing any of the piping. This accessibility of the interior is carried still further by locating on the casing two handholes, so that an inspection on the inside of the pump can readily be made without having to disturb any connections.

In laying out such a pumping plant the proper design of the suction pipe is of vital importance. Care was taken in the present installations to make this part short and straight; and its diameter is large, tapering as it does from 30 ins. at the top to 48 ins. at the bottom. The effect of the large area at the lower end is to allow the water to enter the pipe with a low velocity, and to this point attention has to be paid, for in some of the older installations it was found that the high entrance velocity imposed by a small suction pipe resulted in a whirling motion in the inrushing water in the ditch; the funnels of air which were thereby formed leading to the destruction of the vacuum in the pump casing.

When arranging installation of this kind there arises always the double question of how the pump is to be primed, and as to whether or not a foot valve should be placed on the suction pipe. The method which the dyke engineers have standardized on was adopted in these two new plants; the foot valve is omitted and the priming is accomplished by means of a small air compressor with its connections reversed so as to act as a vacuum pump. By this arrangement the large casing of the centrifugal pump is sucked full of water in a few minutes. The vacuum pump is belt-driven by a 2 h.p. 220-volt, 3-phase motor, the low voltage being obtained from the two lighting transformers.

Pumps—Performance

Great care must be exercised in selecting the pump to see that it has the performance characteristics suitable for reclamation work—that is, that the power required is as nearly constant as possible for all likely heads. For it has to be kept in mind that in such schemes as this the head is likely to vary by 100 per cent., due to the uncertain level of the river in different seasons. This condition demands a pump of special design; in an ordinary centrifugal the power consumption increases so considerably with altered lifts that there would be serious danger of burning up the motor when the head varied from a given normal. This trouble was obviated in the pumps here illustrated by having the pump volute so designed, that the h.p. consumed remained constant throughout the whole range of head, the output adjusting itself to suit. This novel characterisic has allowed the use of a small-sized motor which can be worked to full capacity under all conditions, and yet not be in any danger of overloading. Actually the motor is of only 100 h.p. rating, despite the fact that the pump is capable of delivering the large volume of 30,000 gallons per minute, and although the head is so inconstant that at certain periods it is double that at others. The advantage of having a pump designed so as to automatically safeguard the machinery against overloads is obvious.

To supply these pumping plants with energy the Power Company ran along the dykes pole lines carrying 3-phase circuits of 2,300 volts, which is supplied direct to the motors without transformation. All wiring and switching arrangements inside the station are made simple and safe, so that skilled electricians are not required for operating the machinery. The motor used has a wound rotor, as this type gives the good starting torque required—for the pump, being primed at rest, is half-loaded to begin with, even although the closed gate valve prevents pumping. On gaining speed the rotor resistance is cut out step by step by a hand-operated switch, and on attaining full speed with the slip rings short-circuited the full load is applied by opening the gate valve and so allowing pumping to commence. The switchboard carries an oil switch connecting the incoming lines to the stator. To safeguard the motor against excess current a time limit over-load trip is attached to the oil switch, and furthermore, 2,300-volt cartridge fuses in the primary circuit are aided on the board. So that the building can be completely isolated. An oil switch operated by a rope line is located on the pole outside.

Pump House

As several different styles of pumping houses have been erected on the dyked lands, it will be of interest to describe the type of construction that the dyking authorities have now found by experience to be the most serviceable. What was wanted was a strong, durable, and above all, an inexpensive building that would properly house good pumping machinery. One of the accompanying illustrations shows one of these new pump houses; and it has to be remembered that the small ranchers whose taxes pay for these plants want merely a strong and neat building so designed that the pumps can be run as economically as possible. At such a pioneer stage economy, and not ornamentation, is the ruling factor. To fulfil these conditions it was found that the best arrangement was to build the pump house on piles driven into the ditch. While being amply strong, this construction has proved to be better than erecting on the adjacent land, where not only are concrete foundations necessary, but where considerable excavations have also to be made for the intake well.

The building is made of thick corrugated galvanized iron sheets covering a skeleton wooden framing, which is closely spaced and cross-braced. The overall dimensions are 40 ft x 19 ft. x 10 ft. The floor is placed as low down as possible, in fact only a few inches above the high-water level of the ditch; this allows the centrifugal to be placed where the pump should always be placed—down near its work, with as short a suction pipe as possible. The whole structure sits on 12 in. x 12 in. beams, which cap the twenty-four 12-in. piles. Attention may be called to the fact that these piles are rigidly braced together by diagonal ties, so as to prevent the structure receiving any vibration from the rapidly rotating machinery. The use of cedar piles has assured long life to these foundations.

This simple construction of the pump-house has much to commend it over other more elaborate designs. It is serviceable, yet very cheap. It has an immunity from fire risk not possessed by a plant constructed on solid ground; owing to its isolated location out in the ditch, it is away from the prevalent bush fires. That this fire hazard is still further lessened by the sheet iron construction of the walls was demonstrated lately, when the wooden steam pumping station at Upper Coquitlam caught fire from the bush and was consumed, whereas the new sheet iron electric plant just alongside was saved.

The resultant effect of these pumping schemes has been greatly to enhance the value of the 40,000 acres of dyked land, so that much of it has fetched in sale $500 per acre; while by the combination of cheap power with carefully chosen pumping machinery the annual dyking tax has been kept down to an average of $1.60 per acre; and in time this tax will diminish, as it is paying off not only the cost of the new electric plant, but also of the very expensive original steam stations.

C.N.R. Bridge Work at Calgary

(Staff Article)

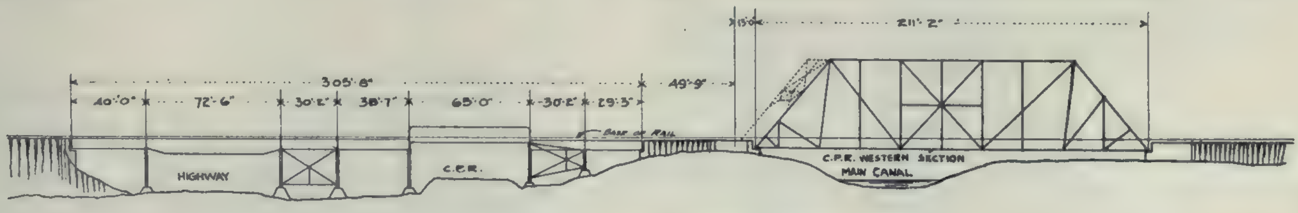
THE Calgary-Vegreville Branch of the Canadian Northern Railway enters Calgary from the East, the route in the city requiring eight bridges, having a total of some twenty spans The many varying conditions to be met and the requirements to be fulfilled make these structures of interest. There are three railway crossings, two highway crossings, one street crossing, two river crossings, an irrigation ditch crossing, and an overhead highway bridge. These include a structure over 600 feet in length, carrying the tracks over the Calgary Canal of the Canadian Pacific Irrigation Department, over the three tracks of the same company, and over the street railway and road allowance between the city and the Ogden Car Shops of the Canadian Pacific Railway; a six-span plate girder bridge across the Bow River; and a three-span combined highway and railway bridge over the Elbow River, in the heart of the city.

Of the entire group of bridges, two are of particular interest—the one for the number of conditions to be complied with, the other for the unusual simplicity of conditions. The tracks across the Irrigation Canal at the vertex of a sharp curve, necessitating a long span truss bridge, with a sharp skew. Immediately west, parallel to the canal bank at this point, are the three tracks of the main line of the Canadian Pacific Railway to their shops, and a few feet further west is a public highway upon which runs the track of the Calgary Municipal Railway. Three requirements as to clearances had to be met at these crossings, and the resultant structure has an aggregate length of almost 580 feet, broken only by the short width of the canal bank. A half-mile further within the city limits the line crosses the Bow River, six-plate girder spans of equal length being built, with a length of 540 feet.

The first-mentioned structure is a through rivetted truss bridge, 211 ft. long, 48 ft. high, with a skew angle of about 34 degrees. There is a short break of about 50 feet across the bank, when the tracks are carried on a plate girder viaduct having seven spans with an aggregate length of 305 ft. 8 ins. The truss has a modified Pratt truss latticing, with counter and horizontal pin connected bracing in the centre panel, the skew angle introducing an unequal panel length. At the east end of the north truss, and the west end of the south truss, there is a panel 25 ft. 2⅝ ins. long, with a panel half that length at the opposite end, and eight intermediate panels 21 ft. 8 ins. long. The trusses are placed 18 ft. 4 ins. on centres, and have a depth of 48 ft., centre to centre of chords, and a length of 211 ft. 2 ins. between bearings. The main bottom chords consist of four 8-in. by 6-in. angles, and two plates 17-in. by ½-in., latticed; the main top chord consists of one cover plate 24-in. by ½-in., two web plates 20-in. by 9-16-in., two angles 4-in. by 4-in., and two angles 6-in. by 4-in.; both members having lengths of practically 50 feet. The top lateral bracing follows much the panel arrangement of the main truss and consists of latticed angle struts. The bottom laterals and floor system are arranged in ten regular panels of 21 ft. 8 ins., having a total length of 216 ft. 8 ins. There are two rows of stringers, 8 ft. centre to centre, composed of four angles, with 44-in. web plates. The floor beams, at the panel points, are built up of four angles 6-in. by 6-in. by ⅝-in., and have a web plate 56-in. by ⅜-n., base of rail being 4 ft. 5 ins. above the centre line of the main bottom chords.

211-ft. rivetted truss C.N.R. crossing over C.P.R. Calgary canal.

The second structure has seven spans, only two of which are equal, carried on steel columns and concrete pedestals, with a total length face to face of abutments of 308 ft. 4 ins. At the east end, next the Irrigation Canal, there are two deck plate girders, followed by a through span across the C. P. R. tracks,



South elevation C.N.R. crossing, Calgary.

then two short spans followed by a deck plate girder span with drop ends, over the highway, and another span west of that. The span crossing the railway tracks has a length of 65 ft., and is raised to a through span in order to gain the required clearance above the C. P. R. of 22 ft. 6 ins. The girders are 17 ft. 6 ins. on centres, and have 96 -in. by ⅜-in. web plates, with flanges composed of two 6-in. by 6-in. angles and two 14-in. cover plates. All the other girders are 8 ft. centre to centre. The span over the street railway and highway has a length of 72 ft. 6 ins., and the web paltes are 100 inches deep at the centre, being cut to 66 inches in depth in a distance of 12 feet from each support. The flanges are composed of six angles and a single cover plate. The through span is carried on 18-in. rolled H-section posts, all the other posts being 14-in. rolled sections. The intermediate spans all have a uniform depth of 5 ft. 6 ins., the two equal spans having longitudinal bracing. There are about 700 tons of steel in the viaduct alone.

The Bow River Crossing is a simple structure of six 90-ft. deck plate girder spans, supported by five concrete piers in the river bed, with reinforced concrete abutments of the wing type. The crossing has a total length of 50 ft. between the abutments, the base of rail being 41 feet above extreme high water level.

Portals, 211-ft. rivetted truss, C.N.R. crossing over C.P.R. Calgary canal.

The girders have an extreme length of 89 ft. 8 ins., are 9ft. 7 ins. deep, and are 8 ft. on centres, weighing about 23 tons each. The top flange section is composed of four angles, the bottom flange of two angles and two cover plates. The bearings are fixed at one end, with expansion bearings at the opposite end.

The erection of these structures was done during last fall and winter, the contractors using a 35-ton 3-drum Lidgerwood derrick car, with a timber boom 56 feet long. The erection of the viaduct was accomplished in eight working days, The Bow River crossing was erected at the rate of three complete spans a week. During the erection of the latter structure, the timber boom broke close to the seat, allowing one end of the plate girder in the leads to drop to the rived below, the other end resting on the abutment. No particular damage was done, however, and erection was completed with a similar boom. The truss span was erected on trestle falsework by the same derrick car. The contractors for the erection of all these spans were Messrs. Frankman Brothers, of Winnipeg. All of the concrete work for these bridges was placed by F. Ferhenbach & Company, Limited, of Calgary. With the exception of the Bow River crossing, which was fabricated by the Canadian Bridge Company, Limited, of Walkerville, Ont., all the structures were fabricated by the Manitoba Bridge & Iron Works, Limited, of Winnipeg.

Safe Loads on Footings

A good method of deciding the safe load on footings is given in the following formulae:—

Divide the total load in pounds by the safe load in pounds per square foot; the quotient is the required area in square feet. The following values for the bearing power of soils given by Prof. Ira O. Baker, have been generally accepted.

Nature of Soil	Bearing power in tons per sq. foot. Min.	Max.
Rock—the hardest in thick layers, (in native bed)	200	..
Rock—equal to best ashlar masonry	25	30
Rock—equal to best brick masonry	15	20
Rock—equal to poor brick masonry	5	10
Clay—on thick beds, always dry	4	6
Clay—on thick beds, moderately dry	2	4
Clay—soft	1	2
Gravel—and coarse sand, well cemented	8	10
Sand—compact and well cemented	4	6
Sand—clean dry	2	4
Quicksand—alluvial soils, etc.	0.5	1

A reinforced concrete pontoon, for a landing stage for ferry service, has recently been put into use in the harbour of Sydney, Australia. The pontoon is 100 ft. long, 43 ft. wide at one end and 68 ft. at the other, 7 ft. 9 in. deep, with a 32-in. freeboard. The bottom is flat, and the sides and ends are sloped to an angle of 70 deg. Special attention was given to the design of the reinforcement, with a view to enable the construction to withstand the excessive forces likely to occur at the same moment. In the construction of the top and bottom of the pontoon, allowance has been made for a live load of 150 tons, distributed over the centre length between the posts. The whole structure is divided into forty-eight water-tight compartments by solid reinforced concrete walls. It weighs about 650 tons.

A deep-water diving suit has been tested in Long Island Sound, off Stamford, Conn., in a depth of 212 ft., which is probably a record for deep-sea diving. The suit is in effect a metal casing, looking curiously like a suit of Chinese armour, and jointed at the elbow knee, hip and shoulder, to allow movement of the diver. One arm is provided with a searchlight and the other with a grappling hook. The casing completely envelops the diver, and is of sufficient strength to resist pressures at least as great as that experienced in the test. According to the owner's report, "no attempt is made to make the suit air-tight, so that all of the water that works in through the joints is kept out by an automatic pump." Air for the diver is supplied through a pipe to the helmet, which pipe also contains a telephone wire.

A start has been made on the footings of the new Registry Office which is to be erected in Toronto at a cost of $400,000. The building is to contain two storeys and basement and will be of stone and brick construction. The architect is Mr. C. S. Cobb, and the masonry contractors are Messrs. J. A. Wickett, Limited.

A Discussion of the Relative Values of Paving Material

IN a paper presented before the Cleveland Engineering Society by Mr. Geo. W. Tilson, a statement of the general laws governing the selection of the type of paving material best suited to the needs of traffic was made. The observations adduced by Mr. Tilson afford in part at least a solution of one of the important problems of the city engineer and as such cannot fail to be received with interest. We reproduce the paper in part as abstracted by Engineering and Contracting.

Stone Block Pavements

Granite and the harder sandstones are principally used in the stone block pavements of this country. The particular kind to be used will depend upon the availability and cost. It would be foolish to consider granite as a material where it must be obtained at great expense and where a good sandstone is available. In this study, however, granite is considered, as it is a material that is used in New York City and one with which the author is most acquainted.

In this connection it should be stated that the figures arrived at in this study by the author must be varied in every locality and must vary to a great extent according to the judgment of each individual engineer. He wishes it understood, however, that he does not consider the exact figures as of so much importance as the method of obtaining the results. So that too much importance should not be given to the results shown.

The granite pavements of today are very much better than those that were laid even four or five years ago. It has been found that on account of their being laid on a concrete foundation it has been possible to reduce the depth of the blocks and make them of somewhat smaller size otherwise, thus rendering it possible to get a better cut block at the same expense as before and allowing the blocks to be laid with a closer joint, thus reducing abnormal wear.

The blocks are laid on a sand cushion on a concrete base, the joints being filled with cement grout, tar and gravel, tar pitch alone, and sometimes a combination of pitch and sand. The author believes that with a small joint and a combination of good pitch and sand the best results will be produced. While a cement grout joint makes a smooth pavement, it is often difficult to close the street long enough to allow the cement to set, and it also makes a pavement that is exceedingly difficult to repair after it has been torn up for any substructure purposes.

In considering the value of different materials as applied to different streets it is assumed that an intelligent selection of the different materials has been made, as upon that will depend the results entirely. For instance, a granite pavement could be laid on a residence street with light traffic, where its durability would be long and the cost of maintenance practically nothing. On the other hand, an asphalt pavement could be laid upon a heavy business street, where its life would be short and the cost of maintenance enormous. If, however, an intelligent selection of material is made for all streets of the city, what will be the natural life and cost of maintenance will be found.

In 1913 in the Borough of Brooklyn the granite pavements cost 3.9 cents and the Medina sandstones 6 mills per square yard, all on concrete.

Wood Block Pavements

Wood pavements have been laid at intervals in this country for some seventy years. The first pavements were not only of untreated wood, but of wood selected without much regard for its natural durability. The result was failure, as could have been expected. The repeated failures of the different kinds of wood, however, although they delayed, did not prevent entirely the establishment of wood in this country as a standard material. The success of the wood pavements in Europe made it positive that they could be laid successfully in this country under proper conditions.

The first treated wood pavement in this country was laid on Tremont Street, Boston, in 1900. This pavement has been in use during this entire period with very small repairs, and is in good condition at the present time. It is composed of blocks treated with a composition made up of one-half creosote oil and the other half resin. Pavements of this character were laid in New York and other cities, but on account of the increased price of resin it was dropped out of the mixture and creosote oil only used.

There has been a great deal of controversy as to the character of the creosote oil to be used for this purpose, the principal point being the specific gravity. The theory of mixing the resin with creosote was that, it being a more stable material, it would prevent the volatilization of the creosote and so preserve the blocks from decay for a greater length of time. The object of treating the wood is to prevent decay and also to make the blocks stable by preventing the absorption of water so that they will not shrink in dry weather or swell in wet and thus cause bulging. It was thought that by using a heavier oil this result could be obtained as well as by the use of a light oil with resin. The relative values of the heavy and light oils have never been determined, but the author has always been in favor of the heavier oil.

The present method of laying wood pavements in this country has not been in use long enough to determine what the cost of maintenance is, but figures obtained from St. Louis, Minneapolis and other cities indicate that it is exceedingly small. Ths first pavement of this character to be laid in Brooklyn was in 1902, and it has had practically no repairs for wear and tear since laid. It is, however, on a light traffic street. The total cost of maintenance of the wood pavements in Brooklyn in 1913 was 1.4 cents per square yard on pavements that had been in use from 8 to 11 years. This cost, however, included, besides actual wear and tear, damage caused by openings in the pavement, although not the cost of repaving the openings themselves. In Paris in 1911 the cost of repairs was 26 cents per square yard. In London the average cost is 20 cents per square yard.

The fillings for joints in wood pavements are sand, asphalt or coal tar pitch, and cement grout. The practice in Brooklyn has been to fill the joints with sand, and first class results have been obtained. Some people, however, prefer the bituminous and others the cement filler; either will give good results when properly used, although the author does not look with much favor on the cement grout filler.

There is no question that wood block is an important paving material, and on streets where the traffic is heavy and noise is a great detriment it is most advisable. Its strongest point is its noiselessness and its weakest its slipperiness. It has been given a value as shown in the table.

Brick Pavements

The author has considerable hesitation in saying anything about brick pavements in such a community as this, where these pavements have been used so long and to so great advantage, and where the engineers know so much more about the subject than does the author. While he has not had so much experience, especially in recent years, with this class of material, he has kept in touch with the subject and recognizes fully the value of this material and the importance it has in the paving industry.

The use of burnt clay for pavements seems to illustrate as well as anything else how quick the genius of the individual is to take advantage of every gift of nature. In this central portion of our country, where there is no natural paving stone, there has been provided a quality of clay which when properly treated produces a material that is almost as good as that provided by nature herself, if not better.

The first brick pavements in this country were laid in Wheeling, W. Va., in 1870, but the material did not come into general use for some time. The author is free to confess that when his attention was first called to brick as a paving material he was not favorably disposed, but the success of the material after it was put into use was such that he was obliged to confess the error of his previous judgment. Many failures have occurred in brick pavements because people did not understand the difference between bricks, and it was not easy in the early days of the industry to determine previous to its use whether a certain brick would or would not make a good pavement, and then it was not known what was the best method of laying. Both of these matters, however, have been fully threshed out, and, in the judgment of the author, this is mainly due to the work of the National Paving Brick Manufacturers' Association, which has maintained a paid secretary to look after the interests of the brick manufacturers, not simply to enable the manufacturers to sell their product, but that every city should get the best possible brick pavement obtainable.

With the present knowledge of the art of making brick and the methods of testing and laying, it is as possible to determine in advance what the results will be with brick as with any natural material.

It is conceded, of course, that brick pavements, like all others, must have a good foundation so that the question at issue, after the bricks themselves have been determined upon, is principally the cushion on the concrete and the character of the joint filling. The National Paving Brick Manufacturers' Association has always been very strong in advocating a 2-in. sand cushion laid upon the concrete. Most engineers in the East, however, believe that only 1-in. is necessary and that no more should be used, the idea being that all that is required is to have a sufficient quantity to allow the brick to be well bedded and have an even bearing over its whole surface. If, however, experience demonstrates that a 2-in. cushion is better than a 1-in., the extra expense is negligible and it should be adopted.

Three kinds of joint filling have been used: sand, coal tar pitch, and cement grout. At the present time sand is not used to any great extent, as it is conceded that a material should be used that will protect as much as possible the corners of the bricks so that the wear may be in accordance with the principle previously laid down in this paper—as nearly vertical as possible.

The question of coal tar pitch and cement grout cannot be so easily dismissed, however. The advocates of both materials are very many and present strong arguments, and it must be admitted that good results have been obtained with both kinds of filling. The author believes, however, that if proper care be taken in the laying and in the application of the filler, cement grout will give the best results, as it will come more nearly to making the pavement a monolith. Some trouble has occurred in the past with this filler on account of the rumbling of the pavement under traffic. This trouble, however, has been nearly, if not entirely, obviated. There is the objection to a cement filler, however, that it is more difficult to open a pavement and replace it in case it becomes necessary on account of the subsurface work.

It is almost impossible to set any figure for the life of a brick pavement or the cost of repairs, as these depend almost entirely upon traffic. The figures given in the table have been made out principally from data received from large cities, and undoubtedly they would be modified if obtained from the state of Ohio, for instance. But as has previously been said, all figures of the table must be adapted to local conditions. The results determined upon are shown in the table.

Asphalt Pavements

Under the head of asphalt will be considered sheet asphalt, asphalt blocks and bitulithic, although the latter is perhaps more often used with coal tar pitch than with asphalt.

Sheet Asphalt.—The first pavement of any note of this character was laid on Pennsylvania Avenue, Washington, D. C., in 1876. So great was its success that it soon came into general use all over the country. While called asphalt pavement, it is almost entirely composed of sand, as the standard pavements have but 10 to 12 per cent. of bitumen, which is the valuable property of the asphalt, the rest being made up of sand and a small portion of stone dust. The pavement is pleasing in appearance, smooth, not noisy, and on light traffic streets seems to be almost ideal. It is more slippery than the hard block pavements, and in the coast cities it is not generally laid on grades over 3 or 4 per cent. In the interior, however, where the atmosphere contains less moisture, it is often used on grades as high as 7 per cent. without trouble.

Data collected from the cities of Brooklyn, Boston, Buffalo, Chicago, New York, Philadelphia, St. Louis and Washington shows that these cities in 1890 had a total of 246 miles of asphalt pavement, and in 1911 2,348 miles. This gives an idea of the popularity of the pavement, although it must be taken into consideration that this was during a period when there was great activity in laying new and smooth pavements. In Brooklyn, for instance, in 1895, there were 18 miles of asphalt pavement, while at the present time there are 540 miles. Brooklyn is a residential city, without many steep grades, and one to which this material is particularly adapted.

The cost of repairs to the asphalt pavements in the Borough of Brooklyn in 1913 was 3½ cents per square yard, and in the Borough of Manhattan for 1912 it was 14.1 cents per square yard, this being due to a great extent to the difference in traffic in the two cities. In the city of Paris in 1911 the cost was 19½ cents per square yard.

In London the contract price on Cheapside per yard per year was 56 cents for 15 years beginning after the pavement had been down two years. The average cost of repairs in London is 30 cents per yard.

Asphalt Block.—This is another form of asphalt pavement and consists of blocks, made under heavy pressure at a central plant, composed of asphalt and broken stone aggregate rather than sand, as is used in the sheet pavement. The mixture of the material can be absolutely regulated and the pressure made uniform, so that the blocks produced should be uniform in density and quality. On account of the stone aggregate being coarser (say from ¼ in. downward) than the sand, the surface of the pavement affords a better foothold than the sheet asphalt, and also on account of the joints between the blocks. So that where a smooth pavement on grades is desired asphalt blocks are particularly desirable. They are used, of course, to a great extent on streets of light grades.

An objection to them is that as they have to be manufactured at one location the entire surface of the pavement must be transported from the plant to the street, while with sheet asphalt the plant can be located at a convenient point so that the haul is not so large. This makes a difference in the expense against the asphalt blocks. On the other hand, however, an asphalt block pavement can be repaired without the use of a mixing plant, as the blocks can be purchased and brought upon the street and used when desired.

Asphalt block pavements in the Borough of Manhattan in 1912 cost 9.8 cents per square yard for repairs, and in the Borough of Brooklyn for 1913 1.2 cents per square yard.

Bitulithic Pavements.—This pavement was first laid about ten years ago. A gentleman who had formerly been interested in asphalt pavements conceived the idea of improving the then existing methods of laying a macadam pavement by filling a portion of the voids with a bituminous product or bitumen mixed with some other material. By the gradual elaboration of his original idea there was evolved a pavement which is now known as "bitulithic." It is essentially a macadam pavement of selected and graded stone, so that the voids in the stone shall be as small as possible, the binder being a bitumen, either coal tar or asphalt, both having been used. The pavement, being formed of coarse materials, can be laid on quite steep grades with satisfactory results. The writer has had no personal experience with this material, but has observed its construction and use in other cities. It has been laid very extensively in this country and would undoubtedly have been used to a greater extent if it were not patented. It is considered as standard and ranks with asphalt pavements.

Traffic

Knowing, however, the kind of material and the properties thereof are not sufficient for the official whose duty it is to determine the particular one to be used, he should also know the requirements of the streets to be paved. In order to do this he should have records of the kind and character of the traffic upon each street, or upon typical streets. Of course it is not necessary to get a total census of traffic on all residential streets, but of those where by an inspection it can be told to what class they belong.

And in speaking of traffic it should be understood that as at present considered the words "heavy," "medium," and "light" traffic mean very little, except with reference to any one particular city. There should be a standard unit of traffic, so that when the traffic on a certain street is given it could be distinctly comparable with traffic in another city. To do this it is necessary that the effect of traffic upon the different materials be known. Little attempt has been made to determine this, but within the last two or three years the English Road Board has constructed a machine for making this determination, and a somewhat similar machine was exhibited at the American Highways Association meeting in Detroit last fall.

It can be easily understood that a vehicle weighing with its load 15 tons will have an entirely different effect upon a pavement than 15 vehicles each weighing 1 ton. It makes a difference, too, whether the tires are steel or rubber, whether they are 1 in. or 3 ins. in width, and whether the vehicle is moving at a rate of 6 or 30 miles an hour. Experiments can be made so that the wear of the different vehicles under different loads can be ascertained and referred to one unit, and until this is done the adjectives "heavy," "medium," and "light" must be considered very indefinite.

I think on the streets that will be subjected to the heavy traffic, it will undoubtedly be necessary in the future, if motor trucks are to be continued with heavy loads as they undoubtedly will, to lay heavier foundations on streets that will be subjected to that traffic. It may be necessary in the large cities to have certain streets assigned for those heavy trucks. I do not think it is fair to a city or the property owners to be compelled to lay pavements with a strength sufficient to hold up those heavy loads, although I was quite surprised in Glasgow in speaking to the engineer about their extreme loads when he said that even under the heaviest conditions they did not use more than six inches of concrete, but in London, on the heavy traffic streets they are using eight inches. If we are going to have these enormous loads, as we undoubtedly are, some special provisions must be made for them.

In connection with these loads, the city consulting engineer of New York had in mind for some time the regulating of these loads by ordinance, and having the people who use those excessive loads pay a license fee for their use. In making investigations, it was found that the large trucks with the wide tires sometimes had a load of 1,500 to 1,800 pounds per inch of tire on the streets, and it was the intention not only to regulate the total load, or load per wheel, but the load per inch of tire. An ordinance was drawn up to accomplish this, but it was finally decided that such an ordinance would be in the nature of a tax, and that these trucks were taxed once by the city, and that they could not be taxed again.

The borough engineer of Fulham, London, has established what he thinks is the wear that will take place on wood pavements under a certain traffic, and, having observed the traffic on any particular street, he figures out how long a wood pavement should last. This, however, is indefinite for the reasons before given.

And even after the value of the traffic unit has been established it will be difficult to apply it positively, as in every case the weight of the vehicles upon it must be estimated.

Then after all that has been determined there are certain local conditions which must also be taken into consideration. For instance, if the traffic requirements are such that a brick or stone pavement should be used for economic reasons, it is possible that hospitals, school houses or churches may be situated on certain portions of the streets, so that it would be necessary to lay wood on account of its noiseless property. Then, too, the official will learn that the wishes of the users of the street and those doing business on it must also be taken into consideration, and he often finds that the two will conflict, as the truckman cares nothing about the noise and the business man cares little for tractive or non-slipper properties. So that, despite all information that can be obtained, in order to arrive at a satisfactory result the different conclusions must be treated together and intelligently. If, however, all these matters are taken into consideration, it is seldom that an improper determination will be made.

Funds for Maintenance and Repair

It might be in order to discuss to a certain extent the economics of the different kinds of pavement. When an original pavement is paid for by assessment upon the abutting property, with repairs and repaving done by the city at large, it often becomes necessary to establish legally just when a street should be repaved. This is more easily determined by inspection in a block pavement than in a sheet pavement, as it can easily be seen when the blocks are worn out, but with a sheet pavement patching can be carried on for a long time and to a great extent without there being any formal repaving. Take, for instance, the case of an asphalt pavement, and assume for the sake of the illustration that the original pavement is paid for by a bond issue continued during the life of the pavement, which in this case is assumed at 18 years. The items of cost in the maintenance of this pavement on a street are: (1) First cost; (2) Interest on the bonds; (3) Annual repairs; (4) A sinking fund to be collected each year to pay for the bonds when they mature.

Assume that an asphalt pavement will cost $2 a square yard, that the interest on the bonds is 4 per cent., and that it will cost on an average 4 cents per square yard per year for repairs. This can be shown in a formula, such as:

$$A + CI + \frac{R}{N} = \text{annual expense,}$$

—when A equals sinking fund charges, C equals first cost, I equals rate of interest, R the estimated cost of total repairs during the life of the pavement, and N the life of the proposed pavement.

Substituting these values in equation we have:

$$.078 + 2.08 + \frac{72}{18} = .198 \text{ for the first period;}$$

—that is, the cost to be raised by the city every year to maintain this pavement would be 19.8 cents per square yard. When, therefore, the annual repairs on a street approximate this amount the question of repaving should be carefully considered. If, however, the same pavement is continued upon the street, succeeding pavements would cost less, as the foundation must have a material value.

The following table shows the cost of different kinds of pavement for a period of years, assuming that granite has a life of 25 years, wood 20 years, brick 15 years, and asphalt and bitulithic 18 years. This life, as has been intimated before, is probably too small for Ohio brick pavements or those in small cities.

Material	First cost, sq. yard	Expense per yard per year first period	Average expense per yard per year, 50 years
Granite	$3.50	$0.294	$0.270
Asphalt	2.00	0.208	0.164
Wood.	3.50	0.308	0.274
Brick	2.50	0.224	0.199

The Brick Road and Its Construction*

By Jas. McCleary

THE question of road building has occupied the attention of the people of the United States for several years. It has been discussed from every viewpoint until people in the remotest areas are familiar with the possibilities of improved roads.

In Ohio, for example, there are 88,000 miles of road, yet the most ambitious of county and inter-county market roads contemplates the improvement of only 9,000 miles. How are the remaining 79,000 miles of highway to be improved if not by inexpensive methods suited to their light travel? Discussing the cost for the more travelled roads, Mr. Frank R. Lander, the Dean of road builders in Ohio, says, "Cheap first cost in road building means nothing more than one of two things, ultimate high cost or complete loss." Cheapness most often stands for extravagance in the end and the adage that "whatever is worth doing is worth doing well" is in striking application to the subject of road building. Yet this false notion of cheapness has prevailed to such an extent that engineers and road builders in Ohio can cite instances where money aggregating millions has been as good as thrown away in road improvements without producing any lasting results, unless to educate the public by experience that ultimate results are more to be desired than cheapness of construction.

A good road can be identified, not by its first cost, but by the amount expended upon it for repairs in proportion to the traffic.

In the matter of grading, I can pass the question of cuts, but a word about fills will not be amiss. Do not place too much trust in a fill which was partially made a generation or two ago. The older portion may be the more treacherous. Perhaps trees and brush were used in making the original fill. If they have decayed, the fill is in a honey-combed condition and likely to give way. The best method of locating voids is by puddling.

Enclose your sub-grade with temporary earth dykes two feet higher than the sub-grade, and divide it into compartments by similar cross dykes. Fill the compartments with water, one at a time, and weakness, if any, will appear shortly. The usual method of relying on a roller for compacting a fill is not nearly so efficacious. In my experience, not more than ten per cent. of the fills could be properly compacted with a roller alone.

Don't fall into the error of thinking that the province of a roller is to purchase a smooth, even, surface on the fill. Rolling, like puddling, ought to help in developing hidden weaknesses where most or different material is needed.

Don't undervalue the necessity of drainage. My rule has been to use it as a precaution in dry places and as a necessity in wet places.

Tile drainage is much better than ditch drainage, but don't place your longitudinal drain beneath the pavement where it is less efficacious in removing the water which the pavement sheds and where, also, it offers a source of back seepage in wet times which may keep the pavement moist and be responsible for shifting in the sand filler. The place for the longitudinal drain is below the gutter. Cross drains should be proportioned in frequency to the nature of the soil and the character of the natural drainage. In some muddy places it may be necessary to lay them every ten or fifteen feet. In other places they will be unnecessary for a considerable interval. The essentials of my practice in under-drainage have been, first, open tile; second, position below the frost line; third, the use of gravel or cinders in filling the trench.

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*Abstracted from a paper presented recently before the Northwestern Road Congress, Milwaukee, Wis.

One advantage of under-drainage as compared with a longitudinal ditch is the lessening of danger to traffic and the more level shoulder of earth that can be graded above an underground drain. Such a shoulder can be kept free from tall grass and weeds by means of a mowing machine.

Be careful not to injure your curbing during the later stages of construction. Careless hauling of heavy loads or machinery over an unprotected edge will cause breaks which expose the brick to abnormal wear. This caution has frequently been violated in my observation.

I would issue three warnings with respect to concrete bases; don't use concrete that is not homogeneous; don't tolerate the existence of voids; don't be satisfied with a finished surface that is not uniformly smooth. In addition to these points, one should observe al lthe other cautions that apply generally to concrete mixing.

The value of the first and second warnings is apparent when you consider that the sole object of a foundation is to strengthen the natural bearing surface and transmit the burden widely and uniformly. The third caution is to prevent such projections or depressions in the concrete as shall result in a different depth of sand cushion at different points.

The importance of this feature will be apparent after the rolling of the brick surface is in progress. An undulating surface of brick means a sounding board effect when the pavement is brought into use and a possible breaking of the bond. Mere spreading of the sand is never sufficient. It should be rolled and re-shaped repeatedly until both the surface and the density are uniform. Too often the road builder contents himself with one rolling after which he fills the depressions with loose sand and finishes the surface with a template. Each refilling should be followed by rolling, a hand roller of 350 pounds' weight being most satisfactory. A soft, uncompacted sand cushion will work up between the brick, when the latter are rolled.

In the culling of brick, good judgment is the exception. Many seeming defects, as viewed by the casual inspector, are not defects. The cull pile may well be examined for later decision on some of the brick that were hastily eliminated. Softness is the chief defect to avoid. Kiln marks frequently indicate unusually good brick, because they are due to fusibility and pressure from the weight of overlying brick in the kilns and fusibility means vitrification. Be sure that your brick are used their best side up. Delivery to setter in such a position is recommended. Be sure that the lugs are all in the same direction. The purpose of the lug is to provide a uniform interstice and permit the grout to descend to the bottom of the brick. Laminations are not to be avoided. If you visit a brick plant you will see that the very process of making bricks entails the existence of laminations.

Don't begin your rolling in the centre of the pavement. Roll adjacent to the curb first, approaching the centre gradually. When the centre has been reached, start at the opposite curb and repeat the process.

Good grouting, like charity, covereth a multitude of sins. No badly grouted pavement was ever a good pavement, but well grouted pavements have sometimes passed muster for considerable periods in spite of gross faults in other details of construction. Three successive applications of a one-to-one mixture of Portland cement and clean sand has been my rule. The utmost care in selecting materials, in supplying the grout and sweeping it into the very bottom of the cracks, will be repaid in results. Anything less than the most exacting care in the application of grout is just like throwing labor and material away.

I dislike to conclude without testifying to my faith in the merits of properly constructed brick roads, based on my ten years' official connection with road building in Cuyahoga County, Ohio. Good brick construction means a highly satisfactory, economical and lasting roadway. Not all Cuyahoga County roads are of this character. It must be borne in mind that Cuyahoga County was the laboratory of brick road experimentation for the whole country and that it made the early mistakes from which other localities, as well as Cuyahoga County itself, were able to profit. In some rare instances, the early lessons were not fully applied in later construction, but take an overwhelming percentage of the mileage in the last ten years and its cost of upkeep can almost be disregarded. Cutting weeds along a rural road may be an item of road maintenance, but it is an expense that has nothing to do with the character of the road wearing surface or its maintenance.

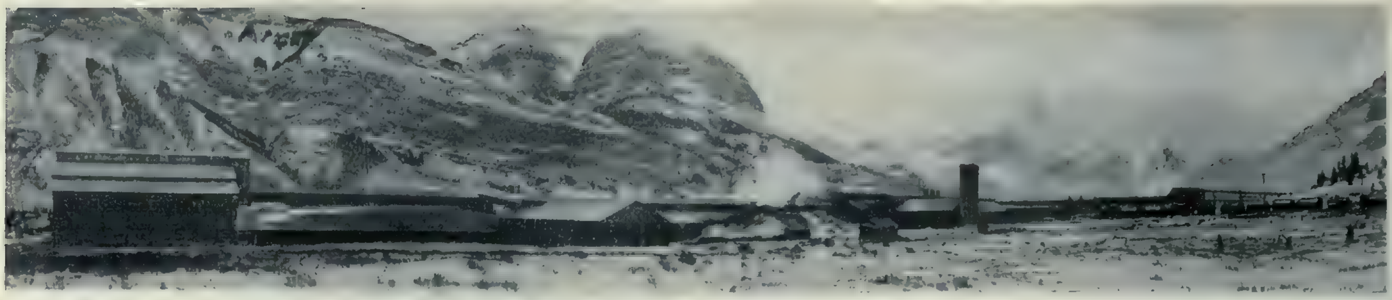
We have roads now bearing a heavy traffic whose first cost is their last cost to date, although they have been down a decade or more. How many decades this state of affairs will continue is a matter that can be only surmised, for, as a government bulletin so aptly states, "no properly constructed brick pavement has yet worn out."

Transcontinental Railway Company's Air-Lift Plant at the New Quebec Bridge

WHAT is claimed to be the largest air-lift plant in the Dominion has been installed by Mr. Wm. Perry, consulting and hydraulic engineer, Montreal, for the supply of water to the Transcontinental Railway Company at the new Quebec bridge.

The water is taken from an artesian well, 1,012 ft. deep, 8 ins. in diameter, and when tested for quantity delivered 5,400 Imperial gallons per hour. Into this well is placed 812 ft. of 3 and 3½-in. pipe, with auxiliary connections. From the ground level a 3-in. Harris pump, connected to a Canadian-Rand drill compressor, delivers the air to the bottom of the pipe. The water instead of being allowed to flow into the tank is trapped into a "booster" and with the air that is collected a pressure of 47 lbs. was obtained. This air forced the water into a tank 85 ft. above ground level, giving a lift of 900 ft. from bottom of pump to top of tank, and delivered over 4,500 Imperial gallons per hour into a tank having a capacity of 70,000 gallons.

The work was done in a thoroughly satisfactory manner by Mr. Perry, who claims to be the oldest pump expert in the Dominion. Since entering the shop in 1851 he made pumping machinery a specialty. Mr. Perry has also installed air-lifting machinery, notably the plant for the Frontenac Breweries Company, with a delivery of 1,500 Imperial gallons per hour. This plant is the only one of its kind in Canada.



Canada Cement Company's plant at Exshaw.

Features of Recent Additions to the Canada Cement Company's Plant at Exshaw, Alta.

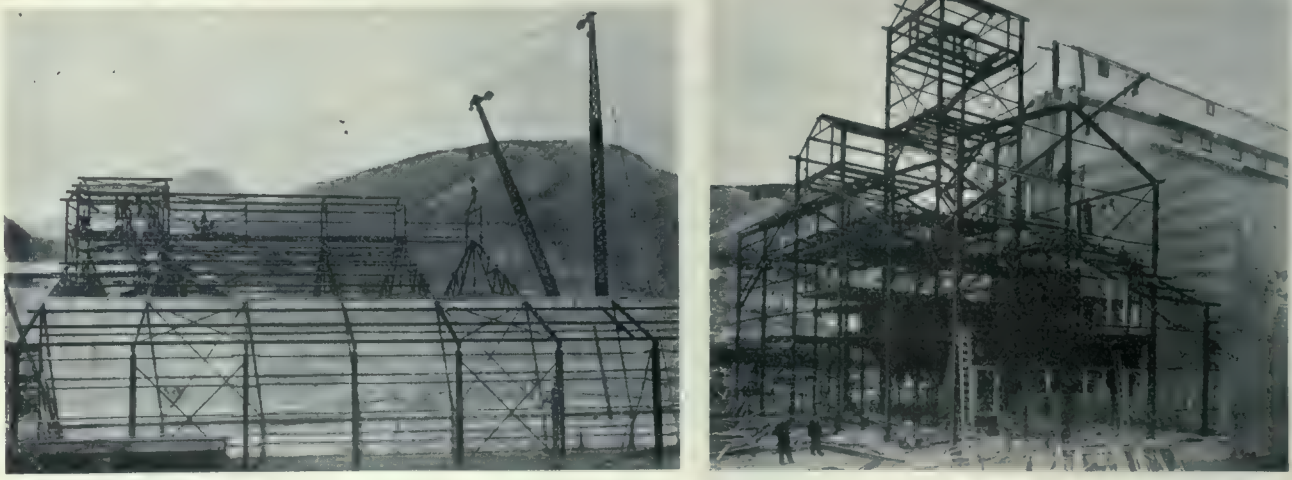
(Staff Article)

THE Canada Cement Company, Limited, have nearly completed further additions to their mill at Exshaw, Alta. These consist of a second reinforced concrete stock house, a bag-cleaning and storage house, and a packing house. The mill is situated just within the eastern ranges of the Rocky Mountains, sixty miles west of Calgary, on the main line of the Canadian Pacific Railway. It has a daily capacity of 3,000 bbls. About a year ago a reinforced concrete cement stockhouse, having a capacity of 240,000 barrels, was completed, and during the past summer construction was commenced on the structures herein described. The stockhouses occupy a site adjoining the railway, and have a total length of 334 feet, being 100 feet wide over all. Adjoining the existing storage house there is a pack-house and bagging-house 100 feet long, with elevators and bagging hoppers; a bag-cleaning and storage house 60 feet long; and a reinforced concrete stock house 172 feet long having a storage capacity of 100,000 barrels. With the exception of the storage bin, the entire construction is structural steel with galvanized iron siding, carried on concrete foundations.

Cement is received on a belt conveyed from the grinding mill and is discharged on to a belt conveyor running over the bin and into the packing house cupola. Cement may then be discharged by tripper either into the storage bin or into the boot of an elevator leg which lifts it about fifteen feet and discharges on to a belt conveyor running through the cupola of the large storage building. Cement is taken from the storage bins by screw conveyors running in tunnels to the packing house, feeding to elevators which lift it to the hoppers over the shipping floor.

The stock house just completed is covered by a monitor roof, there being eight trusses of 60-foot span, carrying the cupola in which runs the conveyor. On either side there is a lean-to, 20 feet wide, the rafters following the slope of the trusses over the bins. The bag-cleaning house is of the same type of construction, the trusses being carried by steel columns, instead of on concrete walls, as in the case over the bins. The bin walls are heavy, reinforced concrete, with counterforts, the walls being 30 feet high. The bag-house is more complicated in its construction because of the machinery installed. It has a total height of approximately 75 feet, being 58 feet long by 100 feet wide. There is a total of 300 tons of steel in the structures, of which 140 tons are in the packing house.

The erection of the steel was accomplished by means of an open steel guy derrick having a 100-foot mast and an 85-foot boom, with a working capacity of



Cement bin.

Packing house.

Constructional views of the extensions to the Canada Cement Company's plant at Exshaw.

15 tons. In the erection of the steel over and beside the concrete storage bins, the herrick was set up inside the bin at the end nearest the other structures, and steel was then taken from the cars beside the bin and placed on either side for the lean-to and also for the roof, thus accomplishing in one set-up what would ordinarily have required several noves and have been more expensive. The same derrick was used to set the balance of the steel, setting the topmost members without any intermediate lifts, though a smaller derrick boom was seated on the structure for handling light girts and other small members.

The steel was fabricated by The Toronto Structural Steel Company, Limited, Toronto, and was erected by Mr. E. M. Huyck, of Calgary. The buildings were designed by the engineers of the Canada Cement Company, Limited, of Montreal.

Standards for the Turpidity of Water[*]

THE principle used for the preparation of turbidity standards as given in the reports of the Committee on Standard Methods of Water Analysis of the American Public Health Association, 1905 and 1912, i.e., that of correcting a standard determined by weight by the use of a field method, is like hitching the cart before the horse.

No two laboratories nor any two persons in the same laboratory working independently in the preparation of silica standards, following the procedure outlined, will make standards exactly alike.

A field method is never accurate and the description of what is "An observation in the middle of the day, in the open air, but not in the sunlight, etc.," ss a source of many possible interpretations. The amount of light, the size, shape and color of the vessel, the fineness of the material, to say nothing of the personal equation, all influence the results.

What is needed is a definite procedure by which standards can be duplicated from time to time by different chemists without variation.

Such a method has been in use in the laboratories of this bureau since 1901. It involves the use of diatomaceous earth, prepared as follows:

"Wash with water to remove soluble salts; dry and ignite to remove organic matter; treat and warm with dilute hydrochloric acid; wash until free from acid and dry thoroughly. Grind in agate mortar, sifting through 200 mesh sieve and dry in desiccator."

Take a weighed amount of finely ground material, about two grains, suspend in 500 c.c. of distilled water, shaking vigorously from time to time for two or three hours. Suspend for ten hours, decant supernatent liquid. Dry and weigh residue. The difference equals the amount in suspension. Dilute to standard and use as stock.

I have found that standards made in this way from different stocks do not differ perceptibly. All material that remains suspended for ten hours appears to be of the same degree of fineness.

We add a small amount of a saturated solution of mercuric chloride and make standards as follows: Use quart bottles of a high grade of white glass free from air bubbles. The standards are 0. 0.5, 1, 2, 3, 4, 5, 7, 9, 11, 14, 17, 20, 23, 26 parts per million silica. For readings above 26, we use a special nesslar jar with a ground glass stopper. We seal these standards. The 100 c.c. standards are 26, 32, 38, 44, 50, 65, 80, 95, 120, 150, 180. For turbidities above 180, dilutions are made with clear water.

During 1913 we made over 24,000 tests with these standards. We have standards made in 1907 still in use. These have been checked from time to time and have not been found to change. We would not recommend using standards over six months without checking.

This method while it is ideal for the preparation of standards which can always be duplicated, involves considerable labor in the preparation of the diatomaceous earth. The introduction of Fuller's earth seems to be a step in the right direction. I believe this was first brought out by Dr. E. C. Levy, of Richmond, Va., in a paper before the Laboratory Section of the American Public Health Association, although in the report for 1912, he s not given credit for it. The idea, of course, is to do away with the tedious grinding and to obtain a standard which resembles more closely the turbidity of water caused by clay.

Working then with two objects in view, of having a definite weight and a definite degree of fineness (obtained by suspension for a definite period) we have experimented with Fuller's earth and have prepared standards which check exactly with our standards made with diatomaceous earth. Our method follows:

If a 200 mesh sieve is not obtainable take aboue 20 grams of Fuller's earth; if a sieve can be obtained, take about 5 grams of the sifted material (weighing is not necessary). Place in a gallon bottle and add about a quart of distilled water, shake thoroughly, as above, and suspend for ten hours. Decant and determine the weight of the material remaining in suspension by filtering 100-200 c.c. through a weighed Gooch crucible. Dry and weigh.

It will probably be necessary to coagulate the material by the use of a known weight of hydrate of alumina or a solution of alum. In this latter case, the water should be alkaline to precipitate the alum.

The total weight will be the weight of the material in solution plus the weight of the hydrate of alumina.

We know then the degree of fineness as we have suspended for a definite period and we have a known weight. From this suspension we can make our stock for use in preparing our standards.

I do not know just how long the standards will keep, as the period elapsing since their preparation is relatively short compared with our other standards, but in any case it is a simple matter to prepare new ones.

We are all familiar with curves of production plotted as a part of the record of work done; but it is not so common to plot those curves in advance of the work done, and by their aid to smooth out inequalities in the demand for labor, and thus operate the whole plant more effectively. The Aberthaw Construction Company, Boston, has found it possible by this means to avoid letting men go temporarily during a lull in the job, to be followed by the hiring of a large force a week later, to rush some particular part of the work to completion. A long look ahead, aided by the plot, has resulted in keeping the force fairly constant for long periods. This makes the workman feel that his job is reasonably secure during the continuance of the building operation. And the lack of efficiency due to the sudden addition of numbers of untrained hands is at the same time avoided by spreading out the whole work more evenly over the entire period.

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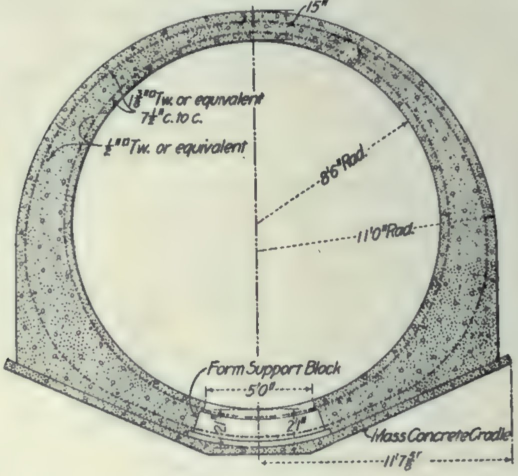
[*] Paper before the Illinois Water Supply Association, by Francis D. West, Chemist-in-Charge, Torresdale Laboratory, Philadelphia Bureau of Water.

Difficulties Encountered in Building a Reinforced Concrete Aqueduct 17 ft. in Diameter[*]

By Geo. T. Seabury[†]

ONE of the many problems involved in building the Catskill Aqueduct, by which New York City's new water supply is to be made available, was the construction of a 3-mile stretch of cut-and-cover conduit capable of carrying 500,000,000 gal. daily under a head of 29 ft. The size of the conduit necessary, because of the allowable gradient, precluded the use of a steel lining, unless that lining were to be assembled in the field. The cost of such a lining would have been a considerable factor. The head that will obtain made a reinforced-concrete structure quite possible, and the necessity of insuring against a deformation that would be sufficient to cause a longitudinal crack and subsequent leakage determined that it be circular in shape. A concrete conduit 17 ft. in diameter and with reinforcement consisting of a pair of rings was evolved.

This massive and relatively simple structure nevertheless possessed some features that rendered its construction particularly difficult and slow. An analysis of the construction details and some of the attending difficulties may be of value both to designers in their study of the elements that cause trouble and to contractors in their efforts to attain the desired result satisfactorily and at a practical cost.



Section of 17-ft. aqueduct.

The effluent aqueduct, so called, is the conduit leading from Kensico reservoir toward the proposed filters. Lying along the margin of the reservoir is the bypass aqueduct. It is similar in design to the effluent aqueduct, but because a steeper gradient is possible the bypass aqueduct is only 11 ft. in diameter and is less heavily reinforced. Through the bypass aqueduct flow to the city may be maintained without the use of the reservoir. The construction problems were common to both structures, but as they were more difficult in the larger conduit attention is here confined largely to that structure.

The interior or waterway is circular, while the exterior is a distorted circle tending toward a horseshoe shape. The transverse reinforcing of the effluent aqueduct consists of two rings of 1⅜-in. square twisted steel rods, the inner ring circular and concentric with the waterway and the outer ring resembling more the outside shape. The pairs of rings are spaced 7½ in. on centers.

In both structures nineteen longitudinal rods of ½-in. square twisted steel are spaced more or less uniformly around the section. In the expansion joints —or contraction joints as they should, perhaps, more properly be called, as it is because of contraction primarily that they eixst—a steel plate 6 in. wide and ½ in. thick is placed around the entire section with a diameter 14 in. greater than that of the waterway and with half of the plate incorporated in each of the two adjacent casts.

The design permitted of no longitudinal construction planes by which an invert might be built in advance of the side walls and arch. It was the essence of the design that between vertical bulkheads the section should be built as a monolith and to this end inside forms were required and concrete blocks provided for their support. It was necessary, therefore, to erect forms completely before any concrete was placed and when the latter was begun to carry it to completion in one operation.

Forms

In the bypass aqueduct Ransome steel telescope forms were provided for the waterway. Each form was 7½ ft. long and was supported at mid-lengths by one of the form support blocks. To facilitate collapsing the forms were divided into four parts. Two symmetrical leaves or segments were hinged at the top in the centre and two others, each consisting of a half of the bottom third of the circle, were hinged to the bottoms of the side leaves. In telescoping, these bottom segments were folded up and then the two top segments, carrying with them also the bottom leaves, were lowered and drawn together, the resulting shape passing readily through the expanded forms.

A portion of the inside forms for the effluent aqueduct was of steel, of Blaw manufacture, and was operated like those of the by-pass aqueduct. On a portion of the former structure the superintendent, feeling that the support blocks were likely to prove a source of leakage, built forms of wood that were supported on I-beams which extended through them near the top of the forms. Between the I-beams and the forms were jacks by which the forms could be lowered sufficiently to telescope. The I-beams in their turn were supported at each end on wooden towers, one of which rested on the completed work and the other on the ground in advance of the work. These forms were in 17.5-ft. lengths and consisted of three leaves, the bottom portion of the circle being one leaf of such a size that it could be swung up and clear the I-beam overhead, as shown in one of the photographs.

The outside forms used in this part of the work were also of wood, consisting simply of frames to which lagging could be nailed as needed. The steel outside forms were ribs made of angles or channels, fitted with plates so arranged that part of them were removable. In all cases the outside forms were held in position by the bulkheads and by tapering bolts tying them to the inside forms. The bulkheads were of wood for use with the wooden forms and for the steel forms were built up of angles and plates. Some of the support block forms were of wood and some were built up of steel and presented no difficulties that careful spading did not readily overcome.

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[*] Courtesy of the Engineering Record.

[†] Formerly Principal Assistant Engineer Kensico Division, Board of Water Supply.

Assembling Rings

The mode of procedure was to move an inside form into position, resting it upon its support block, and to thread on it the reinforcing rings that would be needed between that block and the next. With the wooden form only one length was used at a time. The next step was the assembling in position of the rings of steel reinforcement. This was accomplished by the use of three separators. Each separator rested against the inside form and consisted of two pieces of wood, of which one had notches to hold the rings the proper distance apart, and from the form, and the other was plain, being simply bolted to the notched block to form a cover. The three separators were arranged with one at the very top, from which the rods actually hung, and one at each side to keep the rings distended. The rods assembled, the bulkhead was put on and outside forms erected.

Recognizing that the placing of the heavy and awkward rings of reinforcing would occasion severe treatment of the steep slopes and the bottom, entailing the alternative of a disturbed foundation or an extensive excavation of the muck, with the consequent waste of concrete, a concrete cradle was designed and was always built first. This was only 4 in. thick and performed no function at all save to act as an armor for the bottom, thus preserving it from damage. This cradle was placed even in the soft and friable schist encountered. The illustration on the front cover of this issue shows the cradle and the support blocks and forms.

It was quite a trick to bend the heavy rods to such a shape that when suspended they would acquire of their own weight the theoretical shape required, and it was only by experiment that it was accomplished. The rods, from 57 to 65 ft. in length, were bent around a template of such a size and shape that when the rods sprang free and were then hung in the separators they took the true shape, which was quite different from that of the template. Rod-bending machines were tried, but because of the necessity of changing the relative position of the rolls for the different radii required, and because these twisted rods took on when in the machine a sort of spiral shape, the more primitive method of a group of men winding the bar around a template was found in the end to be much the more economical.

In the early work difficulty was experienced with the bulkheads, which in their removal loosened the expansion plates in the joints, and at times even cracked and broke off the concrete. The bulkheads as then built were all of steel and provided with a slot which half (3 in.) of the plate fitted. This bulkhead wedged tightly and was almost impossible to remove. This difficulty was corrected by leaving this slot in a false wooden bulkhead inside the steel bulkhead. This permitted the steel to be first entirely removed without difficulty or damage and then the wooden bulkhead was taken off with ease when the forms were loosened.

There arose another difficulty which was soon very successfully solved. This was most marked in the bypass aqueduct, where the diameter of the inside form was less and its curvature therefore the more abrupt. Removable plates had been provided in the outside forms to allow for the working of the concrete through the openings so made. These doors, however, were so arranged that on account of the curvature of the inside form not all parts could be reached properly, even with curved rammers. There resulted zones of improperly worked concrete that exhibited more or less honeycombing. The outside forms were almost entirely rebuilt before any considerable length of aqueduct was constructed, and they were so arranged that two-thirds of the area was removable in small plates, which had the further advantage that they could be handled by one man and by him placed without delay to the hoisting plant.

The greatest difficulty of all occurred in the effluent aqueduct; this was due to the diameter of the inside form being so great. It did not prove feasible to pass the concrete in through the openings of the side forms, although chutes were provided for that purpose, the idea being to get the concrete to go by gravity as near to the centre of the invert as possible. The concrete was therefore dumped on the top of the inside forms, which at this point were not covered by the outside forms. Here the difficulty of continually cleaning between the reinforcement led to the adoption of a two-pitched roof, which was removed only when the last of the cast was reached. The eaves of this roof were provided with boards which prevented the concrete from tumbling inside except when wanted, and then only in the quantities desired.

The concrete, in falling, separated; the mortar clung to the circular inside form and the stones fell free, hitting the reinforcing and flying in all directions. Much of the stone landed 10 to 12 ft. from where it was wanted, and it was necessary, therefore, to shovel it over to the centre line and there to ram it and spade and poke it back into the mortar. With 1⅜-in. rods spaced 7½ in. on centers this shoveling was done with considerable difficulty, and it was only by the most persistent effort that the stones were again incorporated in the mass of mortar. The men engaged in spading lay upon their backs inside the reinforcing, and it was found absolutely necessary to have the authority of an inspector on each side of the centre line until the invert was well completed and the concrete began to rise on the sides.

Difficulty With Invert

A further difficulty that arose sometimes in spite of the utmost care was an invert that was not at all points in contact with the inside or cover form. When the elevation of the bottom of the inside form was reached the fluid concrete had a width of about 12 ft., and because of the large diameter circle it met the cover form at such an acute angle that as the concrete was pushed toward the centre it sometimes wedged. In effect dams were formed, one on each side of the centre line, and between these dams there was only mortar, which sometimes was insufficient to fill the space. The placing of the concrete at this point was, therefore, a very slow and laborious task. It was necessary practically to suspend delivery for nearly an hour at times in the larger casts, and because of the physical discomfort suffered by the men it was almost impossible to retain those that had been trained to the necessities of the work, even at increased pay. There was practically the equivalent of a new gang each week or ten days.

The lowest longitudinal reinforcing bar was observed to increase the tendency for dams to form and it was therefore moved a few inches to a higher position, a change which helped considerably. Another thing which helped the inspectors very much was to open small tell tale holes in the bottom of the inside form; and vigilance was relaxed only when all of these holes vented mortar of the consistency which experience had shown to indicate a condition that would prove satisfactory upon stripping.

Points of Interest in New Electrolytic Sewage Treatment

LAST March there was installed in one of the sewage purification plants of Greater New York, that known as the Elmhurst disposal plant, in the borough of Queens, a small plant using electricity as one of its principal features, the object being to permit the city officials to study the operation of this process. A description of this plant abstracted from an article in the Municipal Journal is presented herewith. The plant was furnished by the Electro-Chemical Corporation, being the invention of C. P. Landreth, of Philadelphia.

The plant itself was originally constructed for the electrical purification of water and not of sewage, and therefore certain features of it, referred to later, were not best adapted to sewage purification. The nominal capacity of the plant was stated to be 25,000 gallons per day.

In studying any plant for this purpose, the matter of cost is, of course, an important one, and is referred to in these reports, but the company claims that conclusions as to cost based on this plant would not be fair to the plant, since its form was not that best adapted to sewage purification; the plant itself is small and gives a higher cost per unit than would a large plant, and finally no effort was made to keep expenses down to the minimum, the effort of the company being rather to demonstrate the effectiveness of the plant in securing purification without special consideration to saving in operating costs.

The plant is located in the building of the Elmhurst sewage disposal plant, where approximately one million gallons of sewage a day are being treated by passing it through four sedimentation tanks, the effluent from which flows onto one acre of sand filters; the sludge from the tanks being dried upon beds of pea coal in which steam pipes are embedded, coal and sludge being finally burned under the boilers which furnish the power for pumping the sewage into the settling tanks.

The Electro-Chemical Apparatus

The electro-chemical apparatus was placed on a platform over one of these tanks. It consists of a box of cypress 4 feet 10 inches high and 18 x 24 inches in horizontal cross-section. In the bottom of this is a bank of ten carbon plates or electrodes, and above this are four other banks, each consisting of twelve iron electrodes. All of these electrodes are placed horizontal, and the several banks are separated from each other by a space of about 3 inches, while the iron electrodes are spaced ⅜ of an inch apart. These electrodes are made of low carbon steel and are 10 inches by 16 inches by 3-16 of an inch thick. Sewage is admitted in the bottom under the carbon electrodes and passes between the several electrodes, thence between the several iron electrodes in the first bank, across the intervening space and between those in the second bank and so on; the construction being such that the sewage is required to follow this route. Thus every particle of sewage must pass four times between two electrodes which are ⅜ of an inch apart. After passing through these, the sewage leaves at the top of the tank, is discharged into a flume containing a weir, and from this into a sedimentation tank. The effluent from the sedimentation tank falls into one of the four large sedimentation tanks of the Elmhurst disposal plant, the capacity of which is about 68,000 gallons.

Revolving Paddles

Between each two iron electrodes are two paddles which are revolved in opposite directions, one slightly in advance of the other, and thus aid rather than retard the revolution of each other. These paddles are 9 inches long, ¼ inch thick and 2½ inches wide at the centre, tapering to 1⅛ inches at each end. These are revolved by two vertical shafts of ¾-inch steel which are operated by a motor in the base of the apparatus.

Above the carbon electrodes and immediately below the first bank of iron electrodes is a pipe through which a lime solution is injected.

An inessential feature of the plant is a 2-inch centrifugal pump, which lifts the sewage from the channel which feeds the large settling tanks and forces it through the electro-chemical apparatus.

The carbon electrodes are connected in series. In each bank of iron electrodes, alternate electrodes are connected in groups of threes and these groups are connected in series. The carbon plates, on the other hand, are in parallel with the whole set of iron electrodes, so that nine-tenths of the current is taken by the carbon and one-tenth by the iron electrodes. The iron plates are connected so as to be automatically short-circuited to a zinc plate in the top when the operating current is shut off. A volt meter and ammeter at the front of the machine indicate the current being used thereby. When inspected recently these meters indicated 20 amperes and 7½ volts. This has been the rate and intensity of current used throughout most of the test.

A small tank is provided for making milk of lime, and a small plunger pump discharges this into the apparatus just below the iron electrodes, as previously stated.

Distinctive Features

The devices which we claimed to differentiate this process from any other electrolytic or electro-chemical method of treating sewage, are the paddles and this introduction of lime. The former are claimed to prevent polarization, break up solids in suspension and agitate the sewage so as to bring every particle thereof under the influence of the electrodes, keep the electrodes clean from any deposit and mix the re-agents produced electrolytically. It is explained that polarization is due to the tendency of ions to part with their electric charges more or less reluctantly, the positive ions attracted to the negative pole, for example, tending in some degree to remain positive and thus repel the following positive ions which would otherwise be attracted. The effect of the lime will be referred to later. Another feature is that the iron plates are not diminished in volume by the operation, since they are short-circuited with a zinc plate, thus preventing decomposition and the increased resistance in starting the current experienced in using the older devices.

The reports of Messrs. Firth* & Travis† are abstracted below.

The carbon electrodes, being electro-chemically passive, produce hypochlorite, with its sterilizing effect, from the common salt or other electrolytes present. The lime solution is introduced above the carbon plates because if introduced below, the calcium base being more easily ionized than the sosdium base, calcium hydroxide rather than sodium hypochlorite would be liberated.

In other processes using iron electrodes, the electrodes have been consumed by the action of acid ions liberated from the electrolytes and producing ferric hydrate by dissolving the iron electrodes, this hydrate serving as a coagulent. In the Elmhurst plant, sufficient lime is added to neutralize the acid ions and prevent any eating of the iron electrodes. The calcium hydroxide, being readily ionized, liberates nascent oxygen from the hydroxyl, while the positive calcium at the cathode reunites with water to form calcium hydroxide again. In addition to this, a bulky hydrated calcium carbonate is produced which, with any ferric hydrate formed, furnishes a coagulent which settles out in a few minutes, carrying with it most of the suspended matter.

The amount of lime used at Elmhurst averaged about 1,200 pounds per million gallons. Analysis shows the hardness of the Elmhurst water supply to be 102 parts per million, and the lime necessary to overcome this 496 pounds per million gallons. This leaves about 700 pounds per million gallons of lime available after reducing the hardness. It appears that with perfectly soft water the amount of lime might therefore be decreased by about 500 pounds.

The electric power supply is alternating current, 2-phase, 220 volts, 60-cycle. The amount used for a rate of 25,000 gallons a day was 18 to 20 amperes at 7½ volts, or about one-fifth of a horse-power. As stated above, 2 amperes of the total amount go to the iron electrodes and are seriesed eight times, giving an efficiency of 16 amperes on the iron electrodes. It is considered that with an increase of plate area in larger machines, the voltage could be proportionately reduced, and that about 6 kw. should be sufficient to effect as high a degree of purification as attained in these tests.

That the iron electrodes are not decomposed would appear from the fact that after running for two and a half months the sharp edges of the electrodes did not show any signs of wearing away, nor were there any indications of this a month later. Apparently the only reduction in thickness of the plates was that due to fine sand which was deposited on them for the sewage and moved over their top surfaces by the revolving paddles. It is proposed in the regular sewage purification machines to place the electrodes vertical, allowing sand and other heavy matters to settle in the bottom, where they can be drawn off.

A casual inspection shows that a remarkable result of some kind is produced by the process, the effluent from a small sedimentation tank coming out very clear, and that caught immediately as it leaves the electrochemical machine showing the almost instant formation of flocs of material which settle to the bottom and leave a clear liquid in a very few minutes. Applying lime only in any amount would not, we believe, produce as rapid sedimentation. The effluent in the large tank, which represented the accumulaton of four or five days or more, was very clear, although with a slight yellow tint, and had a very slightly perceptible odor, and that not unpleasant. The same can be said as to the odor from the sludge which was drawn off from the settling tank.

The chemist, Mr. Travis, gives several pages of data containing the results of his analyses, both chemical and bacterial. About six weeks after the plant was started in operation, sewage which originally had a bacterial content of from 1 million to 3½ million, showed 260 directly after electrolytic treatment and 106 after passing through the sedimentation tank; these results being obtained on agar plates, 48 hours incubation. Gelatine plates after 48 hours showed 1,100 bacteria directly after electrolytic treatment and 250 after passing through the sedimentation tank. On July 20, raw sewage showed 20,000 acid-producing colonies per c.c. and treated sewage 2 red colonies on lactose litmus after 48 hours' incubation.

The cost of the process per million gallons is calculated by Mr. Firth to be as follows:

Electricity for electrolysis (not including pumping) at 3 cts. per kw.h.	$4.32
Lime (941 lbs. at $6 per ton, 97% calcium oxide)	2.83
	$7.15

No estimate is made of cost of attendance or of pressing and disposing of sludge, nor of overhead charges.

A larger plant is now being built to be installed at Elmhurst, about 20 feet long and 3 feet square, with vertical electrodes.

Pumping Water by Compressed Air

By Geo. C. Thompson

MANY industrial plants throughout the country experience considerable difficulty in securing an adequate water supply from ordinary sources and are constantly expending smaller or larger sums for the improvement of their impaired supply or the creation of a new source. Ofttimes it is necessary to resort to the expedient of boring an artesian or deep well in those sections where underlying water strata are known to exist. In such sections there are usually more than one stratum to be found at variable depths, having a channel through rock crevices or "faults" or more commonly in a startum of sand. Where the various water strata are definitely fixed by operating wells and the quality and quantity of water being secured is known, it is comparatively easy to determine to which stratum the well should be drilled.

There are two classes of wells, the artesian or flowing well and the deep well; the majority of wells are the deep or pumping wells, the water rising to some distance below the surface. The height to which the water rises is known as the static head of the well. The static head is variable, even with wells in proximity to each other and it is therefore necessary to install some type of pumping device to force the water to the surface. For this purpose, after long experiment and experience, two well-founded and practical systems have been devised; the deep well pump system and the air lift system. Of the two systems this article proposes to deal with the test of an air lift system in a deep well at the North Montgomery, Ala., works of the Morris Fertilizer Company.

The depth of the well in question is 410 ft., and the source of supply lies in a 16-ft. stratum of sand. The well is cased with standard 6-in. drive pipe for 383 ft. In order to prevent the sand from obstructing and filling in the drilled hole below the end of the drive pipe, a 20-ft. brass strainer was "washed" in, having attached at the top, 15 ft. of 4½ in. black pipe with a lead collar for packing off to the 6 in. drive pipe in order to perfect a water tight joint.

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* Engineer of Maintenance, Bureau of Sewers, Borough of Queens.

† Chemist, Bureau of Sewers, Borough of Queens.

The equipment available for the test was a 30 h.p. portable boiler, a 10 x 10 x 10 in. steam driven air compressor. An ordinary hot water or range boiler with a 100 lb. pressure gauge was used as an air receiver. Having connected this equipment, a line was dropped into the well and the static head was ascertained to be 41 ft. below the surface.

Three principles of applying the air lift may be used.

First: Forcing air into the well, provided the drive pipe or outer casing is air and water tight in the well, around the outside of the water or eduction pipe. See Fig. 1.

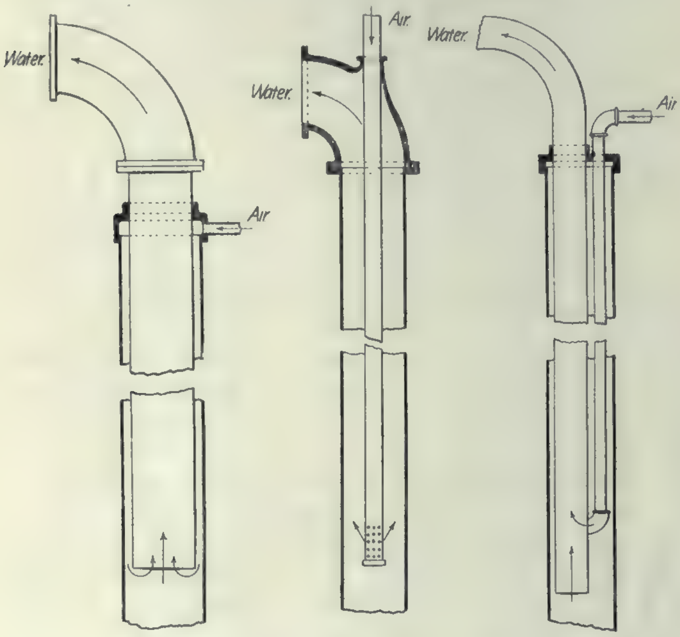

Fig. 1 Fig. 2 Fig. 3

Three methods of constructing an air lift.

Second: Forcing air through a pipe placed within the education pipe. See Fig. 2.

Third: The running of an air line between the eduction pipe and outer casing to a point near the bottom of the eduction pipe, where it is tapped in. See Fig. 3.

For reasons of economical operation it was decided to utilize the principle known as the Pohle system, Fig. 3, but before making the installation it was necessary to consider the elementary principles of the air lift. First, the air and eduction pipes must descend to such a distance below the static head water level as will provide the desired quantity of water commensurate with the ability of the well to deliver it. Each well in this particular must be treated independently and separately. Second, the diameter or area of the education pipe must be in proper proportion to the diameter and area of the air line. That is, a proportionate displacement must be made within the well casing, regardless of the air pressure, for without this, aeration is likely to occur, the air ascending to the surface through the water in bubbles. The volume of water and air admitted for passage through the eduction pipe must be properly balanced. While there are no absolutely fixed ratios for calculating the proper displacement, for ordinary practice, the area of the air line should be approximately one-tenth the area of the eduction line. For example: With an air line of 1 in. diameter whose area is 0.7854 sq. in. the eduction line should be 6 in. diameter, with an area of 28.27 sq. in.

Placing this air line either inside or outside of the eduction pipe, produces an impracticable installation, as in the former case the ratio of displacement is 1 to 35 and in the latter 1 to 36. The correct proportion would be, applying usual stock sizes of pipe carried by the smaller supply houses as follows: Air line 2 in. diameter, area 3.14 sq. in.; eduction line 6 in. diameter, area 28.27 sq. in. The ratio in this case is 1 to 8.9, which while it does not comply with our rule of approximate displacement of one-tenth, provides a satisfactory installation.

Having decided upon the method of applying the air lift to this well, it was now necessary to ascertain the quantity of water the well would yield per foot drafted down as upon this basis could be calculated with reasonable accuracy the total capacity of the well. From the data thus obtained there could be devised an installation that would give the desired quantity of water. Two means of ascertaining this in formation are available: (1) by pumping into the well a given quantity of water in a certain time, or (2) by lifting out a quantity to be measured. Of the two methods, the latter is considered the most accurate and was therefore adopted. With an arbitrary percentage of submergence, the Pohle system was installed. In order to secure the full efficiency of the air available a nipple was screwed upon the inside of the eduction line at the point where the air line tapped in and was turned upward in order to force the air under the column of water between this point and the surface of the water. Later, this practice was found to be wrong, owing to the sand and silt which was in suspension while pumping settling into the elbows when the air pressure was removed, thus forming a permanent obstruction in the air line which no amount of available air pressure would remove, but on the contrary only packed it more securely. This defect was corrected by drawing up the line and putting in a sweeping elbow fitting.

For the eduction pipe, 252 ft. of 3 in. black iron pipe was installed, tapped 16 ft. from the bottom by a 1 in. air line. To measure the water discharged a weir was constructed provided with a blow box and three splash boards to prevent undulations or waves interfering with accurate measurement at the discharge. A square knife edge opening was cut with exceeding care as to accuracy. Three feet above this opening, a nail was driven in the side of the weir at the same level as the bottom of the discharge opening. Around the nail a piece of tin was tacked hemispherically to further prevent any ripples interfering with the measurement of the depth of water flowing through the opening.

Having made all necessary arrangements, the starting pressure required was calculated by comparing the depth of the submergence in feet to the number of pounds air pressure required to raise one foot of water. 0.434 lb. air pressure will raise one foot of water; our submergence in this case deducting the height of static head to the surface and the length of the eduction pipe below the point tapped in by the air line, was

252 ft. — 41 — 16 = 195 ft. submeregence

195 ft. × 0.434 lb. = 84 lb. starting pressure

With a steam pressure of 95 lb. gauge and an air pressure of 85 lb. the compressor pumped 65.448 cu. ft. air per min. When the air was released upon the well the flow began almost immediately. The quantity of water between the static head and the point at which the air line was tapped in, flowed in practically an unbroken stream, after which the flow became intermittent, a "chunk" of water and then air in a pendulum line manner. The starting gauge pressure was 79 lb. and immediately after the flow began dropped to a working pressure of 45½ lb. gauge.

After pumping for an hour, our measurement was taken from the weir and the flow through the 15 in. opening was ascertained to be 9-16 in. or 88.25 gal. per min. to which was added weir leakage of approximately 1 gal. or a total flow of 89.25 gal. per min.

It was observed that the difference between the starting and working pressure was 33½ lb. From this information and also considering the quantity of water secured and the yield of water per foot it is evident that the water is drafted below the static head. Having already calculated that 0.434 lb. air pressure is required to raise one foot of water, then 2.31 ft. of water is raised by 1 lb. of air pressure. It was therefore calculated: 33½ lb. air × 2.31 ft. = 77.38 ft. drafted. This figure includes the pipe friction which must be deducted to ascertain the exact depth and yield. The friction head in this case, pumping 89 gals. per min. 236 ft. through a 3 in. pipe, was approximately 2.54 lb. air pressure or 5.88 ft. Therefore the actual pumping head was 77.38 ft. + 41 ft. — 5.88 ft. = 112.5 ft. below the surface and the yield in gal. per foot drafted was

$$\frac{89}{77.38 - 5.88} = 1.24 \text{ gal.}$$

The well now stands: static head 41 ft. from surface; pumping head 112.5 ft. from surface; yield, 1.24 gal. per foot drafted; percentage of submergence 47.5. Thus to secure 125 gal. per minute, we must draft 125 ÷ 1.24 = 100 ft., and the total head would be 100 ft. plus 41 ft. static head, or 141 ft. From experience it has been found that for a lift of 141 ft. the proper percentage of submergence of the eduction pipe is 55 (see table) or 182 ft. The eduction pipe and air line should then descend to a total depth of 323 ft., air escaping around the outside of the eduction line.

The same size eduction pipe is maintained, but in order to reduce the friction in the air line, its size is increased to 1¼ in. to a point 10 ft. above where the air line taps the eduction line and on account of lack of room between the 6 in. drive pipe casing and the eduction pipe it is found necessary to allow this section to remain 1 in. A condition of this kind should be avoided wherever possible.

The installation is now all complete for delivering 125 gal. of water per minute to the surface. The size of equipment necessary for operation is as follows: The lift of 100 ft. requires 0.48 cu. ft. per gal. of water (see table). The volume of air necessary will therefore be: 125 gal. × 0.48 cu. ft. = 60 cu. ft. per min.

The starting pressure required will be the number of feet submergence, less the static head multiplied by the pound pressure required to raise one foot of water, plus friction in air and eduction lines: 282 × .434 + 8.2 = 130.5 lb. The working pressure, including friction in both air and eduction pipes, is 62 lb. It is readily observed from the foregoing that a standard slow-speed, high-pressure air compressor with a piston displacement of 75 to 80 ft. per min. is required, allowing 20 per cent. and 5 per cent. for the volumetric efficiency of the compressor, for which if belt driven 25 h.p. should be provided.

AIR LIFT TABLE

Lift in Feet	Submergence in Feet	Percentage Submergence	Actual Air Per Gal.	Lbs. Air Pressure Not including friction
20	39	66	.20	17
40	71	64	.26	32
50	86	63	.30	39
60	98	62	.35	44
80	120	60	.41	54
100	138	58	.48	62
125	159	56	.60	71
150	184	55	.68	83
175	206	54	.74	93
200	221	52.5	.80	100
250	250	50	.96	112

Injection of Cement Grout Into Water-Bearing Fissures*

By Francis Donaldson, New York

THE direct injection of cement grout into water-bearing fissures as a means of checking or stopping the flow of water into shafts and tunnels has been experimented with for a decade or longer, and seems to have been first attempted in Europe. It is only lately, however, that the process has been entirely successful. This success has been accomplished on the Catskill Aqueduct, now under construction by the city of New York. This aqueduct includes a number of deep pressure tunnels, reached by shafts for both waterway and construction purposes. In portions of these shafts and tunnels considerable underground water was met. The contract for the first of these tunnels was let to the T. A. Gillespie Company; this section is known as the Rondout syphon. It leads under the Rondout valley at a depth of from 400 to 800 ft., and is about 5 miles long. The engineers expected that considerable water would be encountered, but fortunately this was not the case except at one shaft, known as No. 4, which penetrated the rock at a junction between limestone and conglomerate.

Water-bearing fissures were encountered almost immediately. At a depth of about 200 ft. a flow of 1,500 gallons per minute was struck. The shaft then contained as many pumps as could be used, and it seemed impossible to sink it further. After vain efforts had been made to proceed, John P. Hogan, a division engineer of the Board of Water Supply, suggested that a cementation of the fissures be tried. The process was attempted for the first time in this country.

Since the shaft was partly full of water it was necessary to drill grout holes with a diamond drill. Platforms were placed on the timbers at the water level, the diamond drill was installed, and six 90-ft. holes were drilled in the bottom of the shaft. Several carloads of cement were pumped through these holes into the fissures, the drill casings being used for grout pipes. This largely cut off the flow of water from the bottom and sinking could then proceed. After that, water-bearing seams were grouted as soon as encountered, and the contractor was able to finish the shafts and tunnel within the contract time. Shaft No. 4 was a rectangular, timbered construction shaft with no concrete lining; consequently it was impossible to cut off any of the water coming in from above the point where grouting was first attempted. On this account large volumes of water had to be pumped until the tunnel was finally sealed.

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* Transactions American Institute of Mining Engineers.

At the next wet shaft the writer had to do with advantage was taken of the experience gained at shaft No. 4. At this second shaft, No. 4 of the New York City syphon, good progress was made until a depth of about 100 ft. was reached. The first hole drilled in the bottom below this depth struck a stream of water; the flow amounted to about 150 gallons per minute. This was plugged. It was found that each of the twelve holes in the sump cut encountered the same stream of water.

As soon as each hole cut the water-bearing seam it was plugged with a tapered wooden plug. After all the holes in the sump had been drilled and plugged in this way the grout connections were made one at a time, so as to restrict the flow of water into the shaft. Each connection was made with a piece of 2-in. or 2.5-in. iron pipe about 3 ft. long, threaded at one end and given a long taper at the other. The tapered portion was made rough on the outside by nicking it with a chisel. A heavy iron stopcock was screwed to the pipe, the tapered end wrapped in several thicknesses of burlap, the wooden plug removed from the drill hole and the tapered pipe driven in, the stopcock being left open. This was the most exciting and the wettest part of the job. After the pipe had been driven in hard the stopcock was closed.

The Grouting Machine

In this case connections were placed in all the wet holes before grouting. The grouting machine or tank used on the aqueduct was the Caniff machine, in which the grout is mixed by air. It is built like an air lock with a door on the top through which cement, sand, and water are introduced, and has a 2-in. discharge opening in the bottom and air connections top and bottom. The discharge opening is connected to the grout hole by a heavy rubber hose. Another 2-in. stopcock is placed at the outlet of the tank, and a 2-in. by 1-in. tee is placed between the hose and the cock attached to the pipe in the drill hole. Into the side opening of this tee a 1-in. stopcock is screwed.

The machine is installed at the bottom of the shaft, and is connected to one of the holes and also to the high-pressure air supply. The 2-in. stopcock on the machine is closed and the other is opened. The door in the top is opened, a sack of cement, three or four buckets of water, and (if the cavity to be filled is large) a sack of fine sand are poured in, the air connection at the bottom is opened and the air allowed to bubble through and mix the grout. Then very quickly the door is closed, the lower air connection is closed, and the discharge connection and the upper air connection are opened, and the air enters and drives the grout into the cavity. A man stationed at the 1-in. stopcock keeps opening it a crack; when air shows instead of grout he closes the 2-in. stopcock and the machine is recharged. If the cavity is open the charge is pushed in in three or four seconds. By working continuously more than 1,000 batches can be placed in twenty-four hours.

The grouting of the fissure was successful and sinking was resumed. About 50 ft. further down another water-bearing fissure was drilled into, and this, instead of being open, was filled with sand formed by the crushing of metamorphic gneiss due to folding; this sand was carried up out of the drilled holes in large quantities by the water. Grout will not permeate sand, and it was necessary to continue drilling holes and pumping in grout, increasing the pressure at the end from 100 to 400 and 500 lbs. to the square inch. The sand was tamped so full like sandstone and contained balls of grout from the size of a fist to as large as a man's head.

The most difficult grouting on the aqueduct was done on the Hudson syphon, which is a deep syphon tunnel under the Hudson river at a depth of 1,100 ft. below tidewater. The shafts were sunk by the city forces, after which the contract for the driving and lining of the tunnel and lining the shafts was let. About 150 ft. from the foot of the east shaft the heading cut a water-bearing fissure which flowed about 300 gallons per minute. The full flow did not develop until the cut was blasted. The problem then was to grout this flow against a hydrostatic pressure of 500 lbs. per square inch, with no solid rock to which to make grout pipe connections. This problem was finally solved by the construction of a concrete bulkhead 8 ft. thick across the full section of the head. The concrete was mixed in proportions of 1:2:4, and was heavily reinforced with rails set into holes drilled laterally into the sides, roof and floor of the tunnel. Grout pipes leading into the fissure were set through the bulkhead. After the concrete had set for a week, grout was forced into the fissure, first by the pneumatic process with a high pressure air compressor, and finally by means of a high pressure plunger pump which forced water instead of air into the grout tank. Pressures were reached in this way up to 1,000 lbs. per square inch.

In driving or sinking through rock containing a large number of seams carrying small quantities of water, it is not practicable to stop and grout each seam as described above. In this case it is advisable to increase the section of tunnel or shaft sufficiently to allow for a heavy concrete lining. Drains should be provided opposite all the water-bearing fissures to carry off the water while the lining is being placed. After the concrete has secured sufficient strength, the drains may be grouted. By a combination of these two methods it should be possible to penetrate any firm rock, no matter how much water it contains.

Wind Stress on Roofs

Contributed by G. D. Mills

THE consideration of the force which the wind exerts on a roof slope is one of grave importance when the roof is steep. While there is a diversity of opinion held by engineers, relative to the method by which this force should be determined on different slopes, the ultimate results arrived at do not differ widely. It is conceded that wind usually blows in a horizontal direction, but it is assumed that the effect on the roof is perpendicular to the slope, and that the maximum force exerted horizontally, in a violent hurricane, never exceeds 40 lbs. to the square foot of roof surface. It is also evident that the full effect of this force will be realized on a very steep roof or a slope having an angle of 60 deg. with the horizontal, while a comparatively low slope cannot offer a great amount of resistance to the wind. Wind pressures cannot be determined with any degree of accuracy. Refinement in this direction seems to be more a matter of good judgment than of elaborate calculation.

The generally accepted formula for determining wind pressures on roof slopes is Unwin's or Hutton's, but it is necessary to use Logarithms when applying it, and its use is therefore restricted to those who can readily apply a table of Logarithms in the calculation. The formula reads as follows:

Normal Pressure = Horizontal Pressure sin. c. (1.84 cos. c — 1).

In which

Normal pressure = pressure at right angles to slope c = angle between chord and rafter of roof (1.84 cos. c. — 1) is the exponent of sine c.

From the conceded maximum horizontal wind pressure of 40 lbs. per square foot the formula reads:

Normal pressure = 40 sin c (1.84 cos c — 1)

The results obtained by the application of this formula can be duplicated closely by simple graphics, described in Fig. 1, which may be applied direct to the elevation of the roof in a few moments, without any calculation whatsoever.

The graphics are applied as follows: Erect a line vertical to the slope, as a.e., also one parallel to the roof chord as a.b., set the dividers to 40 on some convenient scale, and commence at point "a." From a to b, from b to c, from c to d, and from d to e, If a.e. is measured with the same scale the dividers were set to, it will record the number of pounds per square foot of wind pressure vertical to the slope, and duplicate closely the results obtained by applying Unwin's or Hutton's formula within a small fraction, in all the roof pitches, from 1/6 pitch to a 60 deg. roof.

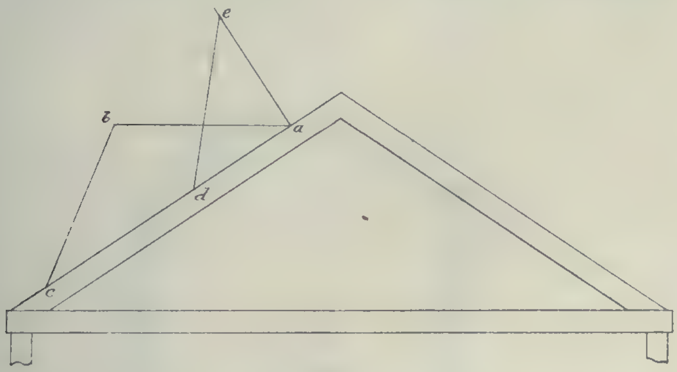


Fig 1

In order to compare the operation of the graphics with the Unwin or Hutton formula, I have devised a formula from the graphics, which is derived as follows: The angle at a is equal to the angle between the chord and rafter of roof as the alternate angles are equal (Euclid I, 29) and the angle at c is equal to the angle at a because a b is equal to b c (Euclid I, 5), and a c equals 40 x cos c x 2. But of b c were extended until it intersected the vertical leg of the right angle, the extended line would be equal to b c (Euclid III, 31), and therefore a c = 80 x cos c. The length a d is found by deducting 40 from a c and a e can be determined by Euclid I, 47, $a\ e = \sqrt{d\ c^2 - a\ d^2}$, from which we may write the formula

$$\text{Normal Pressure} = \sqrt{40^2 - (80 \cos c - 40)^2}$$

Following will be found a Wind Stress Table of the pitches in more general use. The angles are derived from the tangents, tangent 1/6 pitch = 1/6 ÷ ½ = .33333 + tangent ¼ pitch = ¼ ÷ ½ = .5, etc. The results for the Unwin or Hutton formula and also the graphics have been calculated with a table of five place Logarithms.

WIND STRESS TABLE

Pitch	Tangent	Angle	Sine	Cosine	Normal Pressure Unwin or Hutton lbs.	Normal Pressure Graphics lbs.
1/6	.33333+	18°-26′	.31618	.94866	17.	17.6
1/4	.5	26°-34′	.44724	.89438	23.8	24.5
1/3	.66666+	33°-41′	.55464	.83214	29.2	29.9
1/2	1.	45°	.7071	.7071	36.	36.4
2/3	1.33333+	53°-8′	.80004	.59996	39.1	39.2
3/4	1.5	56°-19′	.83214	.55464	39.8	39.7
		57°-4′-40″		.54348	40.	
		60°		.5		40.

A 60 deg. roof limits the operation of the graphics because in Fig. 1 at 60 deg. all sides of the triangle a b c are equal, therefore c d is equal to a c and d e falls on the line vertical to the slope. The limiting angle 57 deg. — 4 ft. — 40 in. in operation of the Unwin or Hutton formula is found as follows. The logarithm of 1.84, which is 0.26482, is deducted algebraically from .1 in order to determine the logarithm of the cosine, which is 1—.73518, and the sum of the two logarithms equals logarithm 0.00000 = 1. The remaining operation is 1 minus 1 plus x 40.

It is interesting to note the small difference which exists in the variety of roof pitches, between the generally accepted Unwin or Hutton formula, and the graphics. The graphics express all that was intended in the Unwin or Hutton formula with an even greater degree of accuracy.

Concrete "Lumber" for Mine Shafts

FIVE shafts on the Mesaba Iron Range under construction last summer by the Oliver Iron Mining Company are lined with concrete sets and five new power plants to operate the shafts are being constructed of concrete building blocks. These shaft sets and building blocks are made at a central cement products plant at Hibbing, Minn., and shipped to the different mines, a maximum distance of 90 miles. The plant consists of a crusher, bucket elevator, revolving screen, one concrete mixer, one concrete block machine, a pocket divided into three divisions, one for sand, one for gravel, and one for "over-size," two steam rooms, and a casting room equipped with an overhead travelling crane.

Handling Concrete Materials

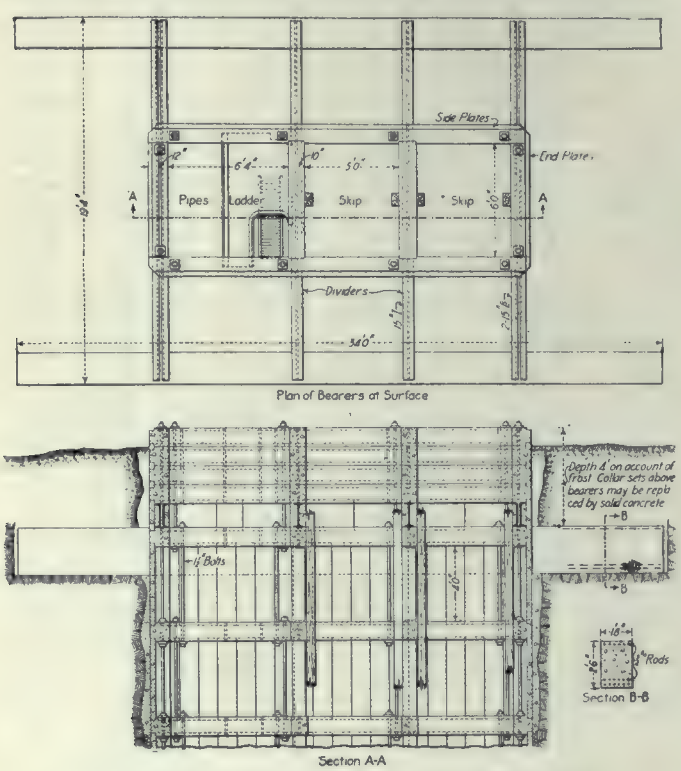
Cement required is delivered in railroad cars on a trestle at an elevation of 21 ft. above the casting room floor, and is unloaded directly from the car onto the cement storage floor. Sand and gravel are obtained from stripping the Sellers' Pit, a distance of about 1 mile from the plant. This material is loaded on stripping cars with a steam shovel and hauled to a large stockpile near the plant. From the stockpile the material is again loaded on small cars, trammed by hand and dumped into the crusher. The product from the crusher is discharged onto the bucket elevator which raises it to the cylindrical revolving screen perforated with ⅜-in. diameter holes in the first section and with 1-in. holes in the second. All aggregate passing the smaller holes is termed sand and that passing the 1-in. holes is termed gravel. "Over-size" is returned to the crusher for recrushing or it may be used for foundation work.

From the bin the aggregate is loaded from spouts and brought to the mixer in a charging car divided into three sections to hold the required amounts of sand and gravel. Cement is poured into the car from sacks before discharging into the mixer. The mixed concrete is poured from the mixer into a distribution car; thence through a chute to the block machine, or it is dumped directly from the mixer through a chute into a car on the mixing floor and trammed by hand to the casting room where it is poured directly into the steel forms for making concrete sets.

Shaft Members

The shaft members are cast in steel forms to shapes of exactly the same dimensions as timber sets for the same size of shaft. Thus no changes are necessary in the various standards of equipment worked out in the different wood-lined shafts which are already constructed. The reason for using concrete sets instead of timber is to eliminate fire risk and to insure permanence. In the ordinary wood-lined shafts it has been found that the timbers soon decay, and after 4 or 5 years the shaft requires continual repairs.

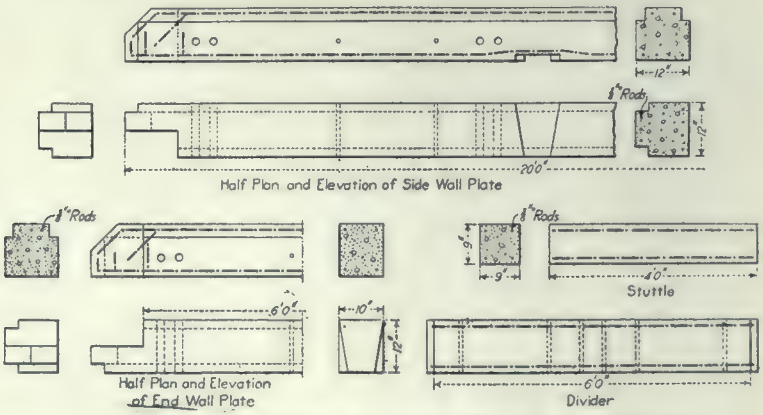
Each shaft set consists of two wall plates, two end plates, each 12 ins. square, two dividers, 10 ins. wide and 12 ins. deep, eight 9 x 9-in. stuttles, and fifty-six 4 x 12-in. slabs for lining. The sets are spaced on 5-ft. centres. Each set is hung from the one above by twelve 1½-in. bolts. At intervals of a maximum distance of 80 ft. steel bearers, consisting of a single 12-in. I-beam under each centre divider and two 12-in. channels (spaced 2 ins. back to back to allow the hanger bolts to pass through) under the end plates, are placed to carry the weight of all sets above. In calculating the weight to be imposed on these bearers no account is taken of the side pressure from the shaft.



Plan of Bearers at Surface

Section A-A

Concrete slab lining behind concrete sets of mine shaft in Minnesota.


12"
Rods
20'0"
Half Plan and Elevation of Side Wall Plate
Rods
Rods
9"
9"
4'0"
Stuttle
6'0"
10"
12"
Half Plan and Elevation of End Wall Plate
6'0"
Divider

Details of the separately moulded concrete "lumber" for shaft bracing.

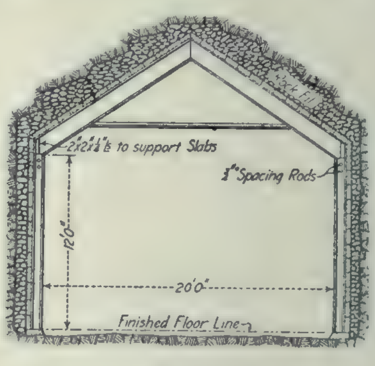
Starting at the collar of the shaft, the first bearers are supported by two reinforced concrete beams, 20 ins. wide by 30 ins. deep. These beams are placed not less than 4 ft. underground to form a foundation to carry the first section of shaft lining.

The cost of concrete sets laid down at the shaft ready for lowering is about twice as much as for timber sets, and the labor of installation is increased but slightly, due to the additional weight.

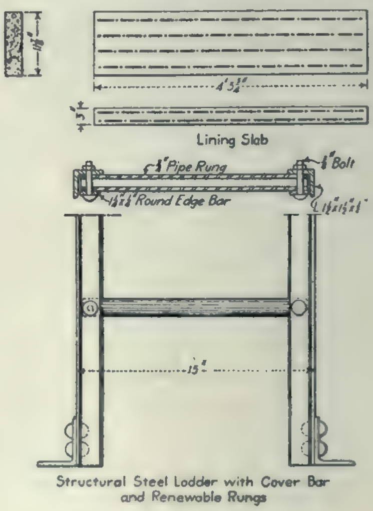
The five concrete-lined shafts and power plants are located at the following mines: Philbin mine at Hibbing, Duncan mine at Chisholm, Wanless and Shiras mines at Sharon, and Minnewas mine at Eveleth. Each of these shafts is about 200 ft. deep.

Underground Pumping Station

The company has constructed successfully an underground pump station at the Leonidas mine, consisting of steel supports spaced on 4-ft. centres and concrete slabs for lining the walls and roof. The station is 438 ft. below the surface and accommodates two crank-and-flywheel Prescott Corliss pumping engines and one compound direct-acting Prescott relay pump. The steel sets comprise uprights of 8-in. I-beams placed on 4-ft. centres, 15-in. I-beam rafters and a bottom chord of angles 2 ft. above the top of the uprights to increase the head room. All field connections are bolted. Concrete slabs, 4 ins. thick, 12 ins. wide and 4 ft. long, reinforced both sides for a pressure of 350 lbs. per square foot, are placed horizontally and backed with broken rock tamped in. At the top of the uprights blocking is carried back to solid rock.



UNDERGROUND PUMPING STATION



Structural Steel Ladder with Cover Bar and Renewable Rungs

Details of ladder and lining slab.

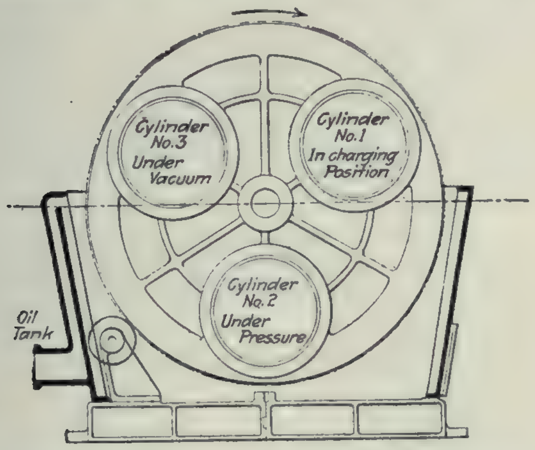
Waterproofing was accomplished by dipping the slabs in hot tar and setting them in neat cement. Tar paper was used to carry off the water, which fell in sheets, until the cement could set. Two coats of white cold water paint were applied after the slabs were in place. A recent inspection disclosed a perfectly dry underground station.

The cement products plant is operated under the supervision of the general superintendent of the Hibbing District. Work at the shafts is directed by the general superintendents of the districts in which shafts are located. Designs were prepared in the office of the chief engineer of the company at Duluth, Minn.—Engineering Record.

A New Type of Creosoting Plant[*]

A CREOSOTING plant of novel type now being tried in Scotland has as its special features an entirely new design of the treating plant, a very high pressure for this impregnation. The retort consists of three horizontal cylinders 33 in. diameter and 28½ ft. long, mounted between two end plates or disks which have openings to receive the cylinders and are carried by a central longitudinal shaft. The entire machine is immersed in an oil tank which is kept filled to the level of the shaft. The general arrangement is shown in the accompanying cut. The end plates are driven intermittently by gearing in such a way that every four minutes the retort revolves through an angle of 120 deg. The movement occupies 18 sec., the retort being then at rest for 3 min. 42 sec.

In the first position, with two of the cylinders above the level of the tank, the cylinder at the right is in line with the feed trough (above the end of the tank) and a charge of 24 ties is pushed in by a ram. The frame then revolves (clockwise) 120 deg., immersing the cylinder in the tank. After 60 sec. (to allow the fluid to completely fill the cylinder), sealing pistons move out and close the ends of the cylinder in 12 sec. A pressure of 400 to 500 lbs. in the cylinder is then raised by pumps in 12 sec. and maintained for 2 min. 6 sec., followed by a release in 12 sec., completing the 4-min. period.


Cylinder No. 3 Under Vacuum
Cylinder No. 1 In charging Position
Cylinder No. 2 Under Pressure
Oil Tank

Sectional elevation of revolving triple retort for creosoting ties.

The frame then revolves 120 deg., bringing the cylinder out of the tank (and immersing the second cylinder). Other sealing pistons again close the ends while a vacuum is created to withdraw a proportion of the creosote. The frame then revolves through 120 deg., completing its revolution, when the charging ram pushes in a new charge of ties, thus pushing out the treated ties at the other end. The operations are the same with each of the three cylinders, so that at each 4-min. interval a charge of 24 treated ties is ejected.

The partial recovery of oil from the wood is one of the features of the system (which is termed the "save-oil" system), and a series of tests of this process and the full-cell process showed results as follows:

	Save-oil process	Full-cell process
Average increase in weight per tie .	21.22%	30.50%
Average creosote per cu. ft.	7.04 lb.	9.97 lb.
Average creosote per tie	2.18 gal.	3.09 gal.

The plant can be adapted, however, for the full-cell creosoting process or for the zinc-chloride process, the vacuum treatment being then omitted. The operation is continuous and rapid, and gives an output of 360 ties per hour. The plant is compact and occupies comparatively little space, but has considerably more machinery than a plant of the ordinary type. It works also on the principle of high pressure maintained for a short period, the actual pressure period being but a few minutes instead of several hours. However, the amount of oil forced into the wood is said to be greater than by the ordinary process. Ties, poles, bridge timbers and paving blocks can be treated in the same way.

The new process and plant are owned by the Save-oil Creosoting Company, Dickson Street, Glasgow, Scotland. Experiments were made first at the Royal Technical College, Glasgow, and as a result of these a complete plant has been erected at the creosoting works of the Glasgow and Southwestern Railway.

The problem of durably tight joints was paramount in the design of the pipe castings adjoining the 66-in. diameter section valves in the city tunnel of the Catskill Aqueduct, according to the 1913 report of the Board of Water Supply of New York City. Research did not reveal any gasket satisfactory for the purpose except wire cloth coated with red-lead paste. After experiments in the laboratory, it was decided that two layers of 40-per-inch mesh bronze wire cloth coated heavily with red lead would make a satisfactory gasket, if the paste were allowed to set properly. The alternative was ground joints; but no precedent for them with diameters of more than 30 in. could be found. It was decided, however, that if a 30-in. joint could be made successfully, 8-ft. joints could be also, and as a result they were specified for some of these castings.

Announcement is made of the death on active service of a son of Lord Cowdray, President of the well-known London contracting firm of Messrs. S. Pearson & Son, Limited. In railway and engineering circles all over the world the name of Lord Cowdray's firm is esteemed for its ability and integrity. Lord Cowdray himself has built railways and pioneered many important commercial schemes in various parts. Sympathy with him in his present bereavement is world-wide in constructional circles.

The Dominion Government has appointed a special committee to enquire into the development of iron ore mining in Canada. In this connection owners or operators of iron ore property are requested to facilitate this enquiry by communicating with the Deputy Minister of Mines, Ottawa, or the secretary of the committee, Mr. J. McLeish, who will furnish a schedule of questions covering the information required by the committee.

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[*] Abstract of an article in The Engineer, of London.

Personal Mention

Mr. Jack McDonald, a bridge builder at Hope, B.C., died in a Vancouver hospital recently as the result of a fall.

The Canada Gazette announces officially the appointment of Mr. R. S. Gourlay and Mr. John Laxton as Harbor Commissioners of Toronto.

Mr. A. W. Wheatley, general manager of Canadian Locomotive Company, has left Kingston, Ont., on a business trip to England. It is assumed that he will endeavor while abroad to obtain contracts from several European countries.

Mr. H. S. Van Scoyoc, of Montreal, who has been appointed chief engineer of the new highway to be constructed between Toronto and Hamilton, has had a wide experience in building highways in Canada and the United States. In addition to constructing roads in nearly every province of the Dominion, he was for five years engaged on municipal work in the United States, most of this period being engaged on permanent highways. The new Toronto-Hamilton road is to be constructed of concrete, and Mr. Van Scoyoc has for some time specialized in this form of construction. He has also had some experience in railroad building. Mr. Van Scoyoc is a graduate in civil engineering, an Associate Member of the American Society of Civil Engineers, and a Member of the American Society of Engineering-Contractors, the American Road Builders' Association, and the American Society of Engineers, Architects and Constructors.

Mr. H. S. Van Scoyoc.

Mr. A. I. Davis, a graduate in Mining of the University of Toronto, has been appointed mining engineer for the United States Gypsum Company at Fort Dodge, Iowa.

Mr. H. W. Scott has resigned as manager of the Montreal office of the Jeffrey Manufacturing Company to become associated with Mr. H. C. Freeman under the firm name of Freeman, Scott & Company, engineers and contractors, of 141 Milk Street, Boston.

Mr. N. C. Nailor, manager of the machinery department of the Canadian Fairbanks-Morse Company, has resigned to enter partnership with Mr. C. S. Rindsfoos, secretary-treasurer of the Foundation Company, of New York City, forming the United States Purchasing Company. The new company aims at effecting the economical purchase of machinery and supplies for contractors and industrial corporations.

Obituary

Mr. Cosmo Cartwright, a graduate in Mining of Queen's University, Kingston, Ont., died October 28, aged 32.

Mr. W. A. McLeod, managing director of the Stewart Machinery Company, died suddenly a few days ago at Saskatoon, Sask., where he was on a business trip.

Mr. Edwin R. Babington passed away at his home, 43 Lee Avenue, Toronto, on October 30. He was born in London, Ont., in 1848, and was a well-known architect in Toronto for over twenty years.

Mr. Donald McDermid, who constructed bridges and other similar works for the Canadian Pacific Railway in various parts of the Dominion, died recently at his residence in Toronto, aged 70 years. He was a native of Scotland.

Mainly Constructional

East and West—From Coast to Coast

EASTERN CANADA

At Montreal, Que., damage to the extent of $20,000 was caused by a fire which broke out recently in the Glasgow Drug Hall, Notre Dame Street West.

In a fire which occurred recently at Halifax, N.S., several buildings were completely destroyed and others seriously damaged. The loss is estimated at about $125,000.

It is reported that a feldspar plant will be erected at Kingston, Ont., in the near future. Mr. C. Schnell, of Paterson, N.J., visited that city recently to select a suitable site.

The St. John, N.B., city council has voted $30,000 towards a special fund for carrying out street improvements. The main object is the relief of unemployment during the winter.

The Port Dalhousie, Ont., Board of Trade has prepared a by-law to submit to the ratepayers next January to authorize the construction of a water-works system for the town.

At London, Ont., there is a proposal on foot to construct a municipal sewage disposal plant to accommodate the east end of the city. A site for the proposed works is being obtained.

At Sarnia, Ont., a new post office and customs house has been completed for the Public Works Department. The work of construction was carried out by Mr. Geo. R. Proctor, contractor, Sarnia.

The basement of what promises to be one of the largest Roman Catholic churches in Northern Ontario is in course of construction at North Bay. When finished the church will cost about $100,000.

At Barton, Ont., Mr. J. B. Nicholson, Township Engineer, is submitting a report on estimates of the total cost of installing a sewerage system in the township at a total cost estimated at $257,863.

A committee of the Dundas Board of Trade is investigating a suggestion in favor of recommending the Town Council to employ an engineer and general overseer of the public works of the municipality.

At London, Ont., the factory of the Dominion Brass Corporation and the plant of the C. N. W. Shoe Company in the same building, were burned down recently. The total loss is estimated at about $20,000.

At Brantford, Ont., work has commenced upon a $27,000 park drive to be constructed around the city. In connection with this work the Brantford Patriotic and War Relief Association has made a grant of $6,000.

Work is beginning on the construction of a 31-room public school on North Leslie street, Toronto. The first section, which will contain twelve rooms, is to be completed by the beginning of April. The approximate cost of this section will be $60,000.

At Ottawa, Ont., the new church which is being erected for the Capuchin Fathers at an estimated cost of $156,000, is nearing completion. Messrs. Noel & Monette, Ottawa, are the general contractors. Mr. Chas. Brodeur, Hull, Que., is the architect.

At St. Thomas, Ont., the Roman Catholic community have purchased the residence and grounds of Mr. John Farrelly, overlooking Kettle Creek Valley, for the purpose of erecting an up-to-date hospital at a cost variously estimated at from $60,000 to $100,000.

The municipal council at Maisonneuve, Que., are constructing baths at an estimated cost of $150,000. At present the foundations are going in, but it is understood that actual construction will not be proceeded with this year. Mr. Marcus Dufresne is the architect.

The Provincial Hydro-electric Commission has awarded the general contract for the construction of a six-storey office building on University Avenue, Toronto, to Messrs. Witchall & Son, contractors, Toronto. The building is to be of steel, terra cotta and brick construction.

The plan which has been prepared of the location of the Galt station of the Lake Erie & Northern Railway, provides for a platform 300 ft. long, running parallel with the Grand Trunk tracks. Midway on this platform and a short distance south of Main Street, a brick station will be constructed.

At Toronto, Ont., the Board of Education is erecting a commercial high school on Shaw and Dewson streets, at an estimated cost of $260,000. The building will be 24-roomed, three-storey, and brick construction. The masonry contract is in charge of R. Robertson & Son, contractors, Toronto.

The Humber Beach hotel, which was constructed at the mouth of the Humber River, West Toronto, last spring, was totally destroyed by fire recently, the outbreak originating in the garage. The loss, which is covered by insurance, is estimated at $57,000 for the hotel and $5,000 for the garage.

The Toronto board of control has decided to devote $840,065 out of the $6,670,000 voted in 1913 for water-works extension, towards the construction of a proposed waterworks system in North Toronto. By this means the work can be carried out without submitting a by-law to the ratepayers.

The city council of Hamilton have adopted a by-law to authorize the raising of $130,000 for the construction of sewers in the east end of the city during the winter. The expenditure of $35,000 on roadway repairs was also sanctioned. Mr. A. F. Macallum, city engineer, will assume charge of the work.

Good progress is being made on the exterior work of a six-storey apartment house which is being erected on Bay Street North, Hamilton, by a syndicate whose architects are Messrs. Stewart & Witton. The building is to be of reinforced concrete construction, fireproof throughout. The estimated cost is $100,000.

Through the E. Laurie Company, Montreal, the De Laval Turbine Company, Trenton, N.J., have secured a contract for a 24-million gallon pump, to be installed at the Point St. Charles waterworks pumping station of the City of Montreal. This is the first pump of the size to be installed by the city. The price is $47,700.

At Hamilton, Ont., Mr. A. F. Macallum, city engineer, has notified the Board of Control that his estimate of $130,000 for the construction of sewerage works in the east end will probably be $50,000 below the actual cost. This increase over the original estimate is said to be due to extra cost of construction during the winter months.

At Fort William operations have been resumed on the new plant of the Steel Company of Canada, and a large number of men are working on the completion of the structure. The building, on which construction was started last year and deferred, owing to the dull manufacturing season, will be ready for operation towards the end of November.

The Toronto City Council has entered into an agreement with the Toronto and Hamilton Highway Commission for the construction of the Toronto-Hamilton concrete highway, at an approximate cost of $600,000. The contribution of Toronto to the scheme will be $150,000, Hamilton $30,000, and each of the other municipalities between the two cities $4,000 per mile.

The Hamilton, Ont., Builders' Exchange have approached the Board of Control with a request that a Chief Building Inspector, who would also be known as Chief Architect, be appointed for the city. The Builders' Exchange also urge the appointment of three outside inspectors and two plumbing inspectors. The suggestion is to receive the consideration of the Board of Control.

At Listowel, Ont., negotiations are in progress for the erection of a factory estimated to cost $100,000. The firm of Libby, McNeil & Libby, of Chicago, Ill., is at the head of the enterprise. Inter-switching facilities between the G. T. R. and the C. P. R. are being afforded by the Dominion Railway Board in order that the company may proceed without delay on the construction of the plant.

At Hamilton, Ont., excavations have been carried out for a $1,000,000 hotel to be constructed on King street east for the United Hotel Company (Royal Connaught Hotel). The building will be of twelve storeys, fireproof construction and will contain 250 rooms. Cut stone, terra cotta, Denison hollow tile, steel and face brick will be used. Messrs. Stone & Webster, Boston, Mass., have the general contract. Mr. A. W. Peene, Hamilton, is the architect.

From Niagara Falls comes the report of proposed boulevards on both sides of the river, running from Lakes Erie to Ontario. The Niagara Frontier Association is endeavoring to have the State build the boulevard on the American side, while the Queen Victoria Park Commission has practically decided to extend the one on the Canadian side. The estimated cost of the Canadian boulevard, from Niagara Falls, Ont., to Niagara-on-the-Lake, is $450,000.

From Ottawa, Ont., comes the information that the programme of public works under construction by the Dominion Government is being carried through despite any financial stringency. To minimize unemployment all works under contract are being carried on precisely in accordance with the intimation of the Minister of Finance in his August budget statement. New works will be entered upon only as the sources of revenue from which expenditure might be met become apparent.

At Montreal, Que., a syndicate is interesting itself in the erection of a theatre and apartment house in that city at an estimated outlay of $300,000. Plans are on the way to completion and tenders for the work will be called shortly. The building is to be equipped with roof garden, grill room in basement and theatre with seating capacity of 3,500. The type of construction will be reinforced concrete, terra cotta, hollow tile and steel. Mr. J. H. McDowell, Drummond Building, Montreal, is the architect.

Messrs. John Quinlan & Company, contractors, of Westmount, have entered an action against the Protestant School commissioners to recover nearly $200,000 in connection with their contract for the new High School on University Street, erected according to the plans of Messrs. Edward & W. S.

Maxwell. The plaintiffs allege that they had to contend with much very costly foundation work in addition to the contract. The contract price was $235,000, and the contractors claim an additional sum of $183,605 and $15,000 damages.

The Architects' Association of the Province of Quebec have under consideration the question of quantity surveying, and a committee appointed to study the subject recently held a conference with members of the Montreal Builders' Exchange representing the general contractors, painters, plumbers, and electrical contractors. A majority of those present were favorable to the adoption of the system, which it was thought would prove economical and of general benefit. The exact form in which to carry out the idea has yet to be decided on, and a further meeting will be held in a short time.

The contract for the construction of the Don Section, Bloor Street Viaduct, Toronto, is still undecided. Recently the city council referred for their opinion the plans and specifications for a reinforced concrete viaduct to the Ontario Railway Board. The Railway Board in a communication to Mr. R. C. Harris, Commissioner of Works, a few days ago stated that the city was "out of court" in sending to the board for its consideration plans and specifications before the city had decided what the construction should be; that it was not within the board's duties to decide an issue between rival tenderers, but rather to approve specifications after these had been adopted by the city. The city council has now referred all the plans and specifications to Commissioner Harris for report and recommendation.

WESTERN CANADA

A refreshment and amusement pavilion, owned by the Winnipeg Electric Company, was burned down recently, with loss estimated at $30,000. Building and stock were partly insured.

The construction of the Canadian Northern line from Medicine Hat to Hanna, Alta., is advancing with rapidity. Eight to ten miles of grade have been completed and over four hundred teams are at present engaged in the work.

At Kamloops, B.C., construction work is now in full swing on a bridge over the C. N. R. to be built near Walhachin, at the first crossing of the route west of Kamloops. It is expected that the structure will be completed by the end of November.

The North Transcona grain elevator belonging to the C. P. R., which sank last fall, has been successfully restored to the vertical again. The elevator now rests on seventy concrete piers, which descend to bedrock. The storage capacity of the elevator is one million bushels.

The Provincial Government of British Columbia has been approached on the subject of the installation of a water supply system for Fort George, B.C. The proposed system will cost about $52,000, which it is the city's intention to repay to the government after incorporation has been effected.

At Vancouver, B.C., official announcement is made of a loan of $6,000,000 by the Dominion Government towards the Pacific Great Eastern Railway, now under construction from Vancouver to Fort George, B.C. The railway is guaranteed by the provincial government and the work is two-thirds completed.

The new $550,000 warehouse at Winnipeg, for the Coco Cola Company, Atlanta, Ga., is advancing rapidly towards completion, the walls having passed the fourth storey. Messrs. Jas. McDermid Company, Winnipeg, are the general contractors, and Mr. Arthur Tufts, Baltimore, Md., is the architect.

At Vancouver, B.C., a law suit has been commenced in which the firm of J. A. McIlwee & Sons, Denver, Col., sue Messrs. Foley, Welch & Stewart, contractors for the Rogers Pass tunnel, for half a million dollars. The plaintiffs had been sub-contractors for pioneer tunnel work, but their contract is said to have been annulled.

At Moose Jaw, Sask., work on the installation of a filtration system, adopted by the city council for treating water from the Snoddy Springs reservoir, will be started almost immediately. The filters will be erected at South Hill and will consist of two steel tanks, 8 ft. in diameter. The total cost of the work will be approximately $10,000.

The Saskatchewan Concrete Post Company, Limited, is to start operations in Regina, Sask., shortly. The new company has an authorized capital of $25,000 and has acquired the patent rights for Saskatchewan for steel reinforcement for concrete fence-posts and poles. Operations will be started as soon as the machinery has been installed.

At New Westminster, B.C., the city engineering department will call for tenders shortly for pile driving in connection with improvements to the penitentiary wharf at Sapperton. The proposition is to extend this wharf about 8 ft., and carry out other improvements. The work will be undertaken by the city under arrangement with the Dominion Government.

From the annual report of the Saskatchewan Highways Commission we learn that of the total sum of $1,200,000 voted by the Saskatchewan government for highways' improvements, $1,002,685 was expended on roads during the year ending April 30, 1914. Of this sum $507,517 was expended in road improvements direct and $417,066 by municipalities under commission regulations. For steel bridges and concrete abutments there was a vote of $300,000, the total sum spent on this class of construction being $337,483.

At Medicine Hat, Alta., a 3,000,000-gal. reservoir, part of the equipment of the Medicine Hat water-works, which was completed recently, is 208 feet long, 96 feet wide, 20 feet 4 inches deep, thickness of floor, 9 inches, thickness of walls—top 12 inches, bottom 24 inches. The reservoir was built entirely of reinforced concrete without any waterproofing compounds, "Canada" Portland cement exclusively being used. The composition of concrete was one part cement, two parts sand and four parts concrete. The contractors for the work were The Canada Cement Company, Montreal.

At Vancouver, B.C., Mr. Geo. J. Bury, vice-president of the C. P. R., has announced that practically half the main line between Fort William and Vancouver had now been double-tracked, approximately 350 miles of double-tracking having been completed this year between Brandon and the Pacific Coast. Several heavy double-track steel bridges are being constructed, grade reductions made and a five-mile tunnel bored through a mountain, 10,000 feet high, in the Rogers Pass. Mr. Bury also stated that the Kootenay Central Railway would be completed before the end of the year.

Book Reviews

Steel Construction. By H. J. Burt. Published by the American Technical Society, Chicago. Four hundred pages, 236 illustrations; flexible leather, pocket size; price $2.75. As a reference book for architects, contractors, civil engineers and designers this work cannot fail to be found extremely valuable. It is intended to provide the facts and formulas needed in designing the steel frame-work for buildings. The principles are explained carefully in order to enable the student to determine the proper limitations of the tables and formulas. The illustrations will be found particularly useful as an aid to solving the problems usually encountered in practice. A unique feature of the book is a complete set of drawings and details in connection with the design of a 16-storey hotel. The author of the book is Structural Engineer for the well-known architectural firm of Messrs. Holabird & Roche, Chicago.

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Alphabetical Index of Advertisers
Page 18

Vol. 28 **November 18, 1914** **No. 46**

Principal Contents

Page
The Hopeful Influence of Trade Adjustment 1393
The Standard of Merit 1394
Love Among the Ruins 1394
"Business as Usual" in Practice 1395
The Deposit Cheque (Letter to the Editor) 1395-6
The Proper Use of the Technical Journal 1396-7
Suggested Design in Reinforced Concrete for the Proposed Bloor Street Viaduct, Toronto 1398-1400
Paints for Cement and Concrete Surfaces 1400-1
By H. B. Magowan
The Wielder of the Weapon 1401
The Functions of a Municipal Engineer 1402-4
By Prof. E. R. Matthews
An Expeditious Bridge Contract in British Columbia 1405
The Construction of the Canadian Northern Pacific Railway 1406-8
By J. V. Nimmo
Proportioning Aggregates for Portland Cement Concrete 1408
New Pulp and Paper Mill at Bathurst, N.B. 1409-10
Cost of a Damp-Proof Timber Floor 1409-10
Portland Cement Concrete as a Paving Material ... 1410-11
Details of Construction Which Make Brick Pavements Good or Bad 1411-13
By F. A. Churchill
Simple Rules for the Weight of Iron and Steel Bars. 1413
Cleaning Pressed Bricks Stained by Smoke 1413
An Interesting Piling Contract at Montreal 1413-14
Construction of Concrete Septic Tanks 1414-15
By Percy H. Wilson
Causes of Failures in Concrete Structures 1415-16
Construction of Retaining Walls for Deep Basements in Clay Ground 1416-17
Personal Mention 1418
Constructional News 1419-20

The Hopeful Influence of Trade Adjustment

It is encouraging to note that the last traces of the panic which broke out in some influential quarters at the beginning of the war are fast disappearing. In spite of the general depression of trade there is a note of optimism in the recent statements of industrial leaders, financial men and others. As far as Canada is concerned, one of the most interesting statements was made in Washington a few days ago by Sir Geo. Paish, the eminent economist, who expressed the opinion that in many ways the war would stimulate trade greatly and, that the present situation would impel the United States to enlarge its operations as a money-lender. According to this authority, our neighbor to the south will have to decide whether to continue to lay additional tracks on its railroads, construct costly terminals and build beautiful buildings, or whether it will take up the task of helping to furnish capital for the world's development, and particularly for the newer countries on the American continent. Sir George points out that trade activity is a normal condition during war time and that the industries which become very active because of the war cannot fail to have a buoyant effect upon many others. So far from anticipating depression, or continued depression, next year, Sir George speaks of the possibility of a considerable trade revival, there being every promise that the embarrassment in connection with the marketing of the U. S. cotton crops—which is one of the underlying factors—will be removed. Having regard to the constructional projects of our provincial governments, municipalities and railroads, such views coming from such an authority, are reassuring.

In regard to what has been said about the impetus provided by war orders, it is not difficult to substantiate theory by fact. Quite a number of Canadian firms have fair-sized initial orders for steel shells, while contracts for barbed wire have been productive of activity in several other plants. Mr. J. H. Plummer, President of the Dominion Steel Corporation, stated in the course of a recent interview that his firm was receiving a considerable amount of new business from England. Contracts for many other lines are being withheld from Canadian manufacturers pending enquiry as to their ability to turn out the orders on time. We are told on good authority that one block of such orders is for 1,000,000 shirts, 1,000,000 pair of shoes, 1,000,000 sweater coats, 1,000,000 pair of socks and large quantities of underwear. With the award of such contracts in Canada, a wide industrial range would be affected for the better.

This readjustment of conditions is what we predicted from the first. Immediately following the declaration of war everything became disorganized and in many quarters the greatest depression prevailed. The situation was without precedent, The Kaiser loomed up as some frightful octopus whose tentacles would reach out and envelop the world. Such was the fear of God which a one-man military machine could put into the hearts of some at least of the people of the Empire. Now all this is changed, and with a further demonstration of Great Britain's slow-moving but inevitable might, confidence has been restored in a large measure and the men of little faith are joining forces with those who stood their ground from the first.

It is possible that the war may last some time, although by some optimists it is declared that next Easter will see the end of hostilities. But in any event we can afford to wait. We can hold our own and more; we can reach out after new business and get it; and when the war is over we can make up for the business which we have been obliged to sacrifice temporarily.

The Standard of Merit

OPPORTUNITY is a word whose initial letter resembles more nearly than any other the emblem of infinity. The reflection bears upon the approaching opportunity of Canadian manufacturers to extend their overseas trade. This opportunity could not have been brought about for many a long year by any other medium than the war and it should be made the most of. The extent to which the circle of opportunity will enlarge must be governed appreciably by the manner in which the initial orders are executed in accordance with the specifications and requirements of the various authorities and private firms abroad.

The fundamental basis of trade expansion is efficiency. This fact cannot be impressed upon our manufacturers too strongly at the present time. Canada's place and reputation in the British Empire for the next century may depend upon the course she takes during this great conflict. It were a strange contradiction to contribute some of the best of our manhood on the one hand and on the other to condone anything like scamped work in the execution of war contracts. Such things have been done, but it is for Canada to prove herself above suspicion.

At this time it is in our best interests for the initiative to be taken by manufacturers who combine a full measure of business enterprise with an unswerving devotion to the basic principles of integrity.

Love Among the Ruins

(From the London Builder)

SOME of us have probably been led to wonder how it comes about that in the midst of the agony of human sacrifice and in all the tragedy of slaughter there is still room in hearts and minds for grief at the destruction of ancient buildings. War adjusts values. It makes us face the very elements of existence, and throws into the shades of dim distance many things which in days of peace make the foreground of our daily landscape. Are we, one is tempted to ask, allowing sentimental archaeology to linger on and to be cherished when it ought with the other unnecessaries of life to be set aside in these days of fierce reality? The answer is to be found in a few thoughts on the meaning of patriotism. Sentimental archaeology may not, after all, be as empty a thing as the two words suggest. "Sentimental" may imply sentiment rather than sentimentality. Archaeology may indeed mean what it literally means, the knowledge of certain ancient things. Sentiment is what heroes die for, and for ancient things, such as world-old truths, they both die and live.

By this time there is many a home in England in which the poignancy of a personal sorrow overshadows every thought except a sad joy in having been chosen to make for England the sacrifice which is more bitter than death. But among those who merely weigh with deep national sympathy the losses of their nation and of her Allies there is certainly a strong sense of the horror of battered buildings, of towns and churches demolished and disarrayed which holds its own against and alongside of the lament at the fall of brave men.

The defacement of Reims, the effacement of Louvain are calamities which touch the springs of regret not merely in students of architecture, in churchmen, and in scholars, but in all to whom the brotherhood of man is a reality. And why?

Let us think of patriotism. Patriotism is the love of country, and by the common consent of all civilized and uncivilized nations there is but one measure of that love—a willingly given death. The country for which its sons will not die is a country of no account. But for what do these men give their lives? Not surely for a barren aggregation of acres. There is nothing in mere land, though there may be something in mere landscape, for which the sacrifice of wounds and death would be cheerfully paid. No. The potency of land is that it is the measure of fellowship in space, and the potency of certain other things is that they are the measure—nay, the vehicle—of that same fellowship in time. When Aristotle discovered that man was "a political animal" he signified that man is the brother not only of his chosen contemporaries, but of a line of predecessors and of anticipated successors. And this truly is the secret of that patriotism for which men pay the highest payable price.

In a small way this is illustrated by the home. Modern civilization, it is true, accustoms men to think lightly of a change of house; in fact our uprootings from one place of shelter to another are so frequent that if we did not purposely deaden the instinct of our local affections life would be unbearably saddened by removals. In a way we find an anodyne by lavishing our love upon the movable parts of the home. A loaded furniture van is a thing to which a right-minded man might kneel bareheaded. It is to some fellow-creature the ark of the covenant. What the poor call their bits of things are veritably a slice of that possession for which in its national entirety we send forth our guns and our ships. And this not because it is property, but because it is a symbol of companionship. Again, these possessions, being inanimate, have for a time at least the power to evade death and so outlive their possessors. Heaven forbid that this should be an argument for the perpetual hoarding of family furniture! We recall the affectionate reverence for those inanimate companions of humble homes merely to prove the claim of greater things which, being beautiful in themselves and of long and honourable life, outlive not merely their first owners and creators, but generations of their successors. Great and noble buildings, time-hallowed churches, ancient towns whose streets have been worn by generations of faithful citizens—these are things which, being in themselves mere by-products of national energy, are yet sacred and as far as may be abiding pledges of the continuity of race. They symbolize, or rather they are a part of, the common heritage of the men who own them. Apart from beauty, apart from function, they are in themselves evidences and outgrowths of that continuity which makes a man one with the past and future of his country. And when to this property of materialized fellowship is added the grace of beauty and the equal grace of hallowed association it is clear that these monuments of national life are supreme elements in that sacred thing which is the shrine of patriotism. A noble and ancient church, a university of proud and historic lineage, a town of honourable tradition contain in their bricks and mortar, in their very stones and timbers, values which are certainly no less sacred than the hills and valleys, the soil and the streams of a Fatherland.

When, therefore, an enemy effects any wanton or unnecessary damage on buildings of these kinds he is committing an outrage of manifold iniquity.

Assuming the necessity of war, each combatant has the right to inflict death on those brave men who fought for the defence of what they hold dearer than life. But the enemy who outside the exigencies of war wrecks the buildings that are the pride of his adversaries' land is dishonouring the very laws of combat. He takes from his foe not merely the life so willingly sacrificed, but the very things for which that sacrifice is made.

Heroes fight for their country. By their country we mean the continuity of their race, the honour of their women, the safety of their aged and their young, their native soil, their national possessions. The merchandise of war is life and blood, and the trafficker in that horrible market who reaches out impious hands to take toll in more than wounds and death is breaking the rules of war's compact of murder. The foe stakes his life. To rob an honourable foe of more than life, save in the settlement that follows capitulation, is to take from war its last justification.

And so for Louvain, for Reims, as for wasted fields and desolated innocence, we mourn with a lamentation that is righteous. The very dead call out to us to do so.

"Business as Usual" in Practice

MESSRS. Veritys, Limited, electrical providers and manufacturers, of London, are a first-rate example of an enterprising English firm that takes the trouble to let its overseas customers know that their requirements may be filled promptly and satisfactorily. Here is an extract from a letter which we received from them last week:—

> "Our factories are working as usual; deliveries are normal, and we are experiencing no difficulty in obtaining supplies of raw material. Prices have not been altered and there is no reason why business should not be conducted as usual. To cope with the extended business which will undoubtedly result we have already taken steps to increase our factory accommodation, adding three new bays to our works."

Here is a firm which gets right after new business in the very teeth of depression and seizes upon new opportunities with such success that while millions of men across the narrow strip of the English Channel are engaged in the world's greatest war, it finds the extension of its plant essential. The example is one to be upheld throughout the length and breadth of the Empire; for it may be asserted safely that devotion to business is as much the complement of military enterprise as watching is of praying.

It is stated that 600 cities in the United States are using hypochlorite of lime for water sterilization, and that no city following a proper procedure has found it necessary to discontinue its use. In a paper by C. A. Jennings, read before the Illinois Water Supply Association, statistics were presented to show that hypochlorite treatment is now firmly established, as it has accomplished what its conservative advocates originally claimed for it. The selective action on germs of water-borne disease has been proved by bacteriological analyses and typhoid statistics over a period of nearly six years. Of the eight cities the maximum reduction, 72 per cent., was in Cleveland, and the minimum, 35 per cent., in Baltimore. The average was 51 per cent.

LETTERS

The Deposit Cheque

London, Eng., November 4, 1914.

Editor, Contract Record:

Sir,—I regret not to have been able to reply earlier to your correspondent, Mr. R. De L. French, whose letter appeared in your issue of September 16. Unfortunately, the postal departments (both here and in Canada) appear to have gone to pieces at the first shock, and I had the pleasure of receiving by the one post four successive weekly issues of your paper. They had, I understand, been hung up en route, and here clearly there seems a case for the postal authorities to deposit a very substantial cheque in order to ensure due performance of their contract. This is such a "radical" suggestion that I still "hesitate to use my own name." We are under a sort of quasi-semi-demi-martial law here (at least as regards beer and brilliance) and I might be taken out and shot, or given forty-eight hours in the clink (to use a military term) in the morning.

Mr. French does not advance his argument by assuming that "the moral tone of the English contracting world is so high that a deposit cheque is not required." I know that this is "writ sarcastic"; but I will take him seriously and hasten to assure him that trade morality is no higher (or no lower) in England than it is in Canada or anywhere else. In the expression "business is business" may be summed up the world's trading morality. Whatever may be said, contracts are daily executed in England without resort to the deposit cheque system, and there has not as yet been any movement among English contractors to introduce it. If the Canadian or United States contractor doesn't object to weighing out, by all means let him; but it is incorrect to say that the deposit of a cheque is a "necessary formality." It is quite unnecessary.

"Failure to execute a contract does not," says Mr. French, "necessarily mean the forfeiture of the cheque." I must confess I was somewhat staggered when I read this, but Mr. French hastens to reassure me that I was about right in my radical attack. Sometimes the balance is returned," he adds, "after deducting the cost of a reletting, but more often a bidder is held responsible up to the amount of his cheque, for any difference in cost between the original tender and the price at which the work is finally awarded." I fear that there wouldn't be much of the cheque to return in the majority of cases.

On one point I sit corrected, and accept the statement of Mr. French, to whose experience of Canadian contracts I can lay no claim. He is in agreement with me when he says that " the deposit cheque will be returned to the bidder upon the execution of the contract," although he should have said the "satisfactory execution," or rather perhaps, "the execution to the satisfaction of the engineer," which may not be quite the same thing. He adds that "if the contract be not awarded within a specified time" the deposit cheque will be returned, and this certainly knocks the bottom out of the one point (although not the most vital by far) of my argument.

Mr. French gives his whole case away when he says "as long as human nature is what it is . . . . a deposit cheque or bidder's bond . . . . " A bidder's bond, certainly. It is the rule here, in the case of important contracts, for the contractor to obtain two bondsmen for due performance; but that is not quite the same as the deposit of a cheque. An owner will think twice before commencing an action for non-performance. He need not think at all when he already has the damages in his bank. On the contractor would fall the onus of taking action.

The best and only way "to protect a client against the loss of time and money" is to get a good contractor and to see that he is paid a fair price for his work. To bind a man down to a low price is bad engineering, and whether a cheque has been deposited or not doesn't alter the fact. Never once in my private experience have I attempted to coerce a man into standing by his tender, and in my public experience I have been able to bring the bodies I have served round to my way of thinking. It is, I am convinced, both the sensible and the honorable course to allow contractors at the foot of the list to withdraw their tenders. To make them stand to them is to court dispute, litigation, delay and scamping.

Yours faithfully,
"An English Reader."

The Proper Use of the Technical Journal

HELPFUL suggestions as to the reading of the technical journal and the manner in which articles of special interest may be filed and indexed, are given by Mr. J. W. Alvord in an interesting paper presented recently before the Federation of Trade Press Associations. At the outset Mr. Alvord observes that technical papers, constituting as they do practically the whole interchange of experience, form the repository of the profession.

With the rapid increase in and specialization of technical knowledge, engineering literature also has had to specialize, divide and concentrate. The problem of the engineer to-day in relation to his reading is to sort out, discard and eliminate that which he cannot use, and limit himself to the inspection and reading of that which bears principally on his selected professional specialty.

That we cannot keep abreast of the times without reading the technical journals is obvious. That if we carefully read all the technical journals in our chosen specialties we would have no time left to earn a living is easily capable of demonstration. The problem confronting the engineer is how to obtain the greatest good from this ever-increasing flood of information. Some engineers confine themselves to one paper, others take all they can afford; some carefully bind and shelve their copies, still others read what they can and then throw them away. As a rule, however, the engineer prizes his technical paper and endeavors in some ill-defined and formless sort of fashion to preserve its information for future use. The problem affects each engineer differently, according to his age, station and aim in life. To the man whose aim is only to get money and more money, the technical journal is a newspaper in which he may notice mainly where there are better jobs than his own to be obtained. To the man who is anxious to fit himself every year for something better, there is an opportunity for a great variety of study. To the young engineer it is, if properly read and noted, a part of his post-graduate course in engineering; to the middle-aged man it is a mine of data bearing in all sorts of ways on his work.

It is safe to say that to the young engineer and college graduate, engineering lireture will never have any proper perspective until he has been connected in some capacity with engineering work, be it ever so modest a capacity. With the actual doing of engineering work, however, should come co-temporaneously the reading of technical journals, particularly along the lines in which he is working. Nothing can be more instructive, broadening and enlightening to a man doing a particular kind of work than reading at the same time about similar work.

It follows therefore that the young engineer should, as early as possible, take at least one first-class engineering journal and own it himself; bind it if he can afford to, but in any event lay it away in an orderly manner. If one might advise, it would be to suggest enforced systematic reading of all articles particularly bearing on the line of work a reader is immediately engaged upon, and the optional reading only of such other articles as interest him. Some engineers are omnivorous readers by instinct, but it is to be doubted if laborious reading of all kinds of engineering articles all the time is advisable for anyone.

The matter of indexing is an especially difficult one for the young engineer to solve. It is probably not wise for him to indulge extensively in card indexes, filing systems and the like for topically arranging his valuable technical articles. Few men know very early in life where fate and interest will land their future attention, and filing systems and special indexes, which are expensive and time-consuming, when indulged in without definite aim nearly always quickly become too voluminous and thereby useless. If any suggestions are made along this line, it would be to start a loose-leaf notebook, letter size (8½ inches by 11 inches), and note in it (with separate pages for separate subjects) only what appears to be extremely useful, either in exceedingly brief abstracts from articles, or diagrams, costs, etc. These notes will be most useful if they are confined to that kind of work in which the compiler is immediately engaged, or at the most, work very similar to his own which has perhaps had his personal inspection.

The young engineer is tempted to read much about large enterprises—the Panama Canal, big bridges, astonishing tunnels, great dams, etc. This does no harm and probably holds his interest for the time being, but he gradually learns that, for him at least, the chief value of the technical journal does not lie in its dramatic side, necessary as that may be for our general information, interest and pleasure, but its chief value lies in a fund of small things which make up the routine work of the ordinary average job. These are to be watched for and noted, as practically useful to the average man.

For the man in early middle life, actively engaged in his profession, the problem with respect to the technical journal is the absence of time. There is much repetition in engineering writing and in the production of engineering papers, but each new generation needs the same drill in its reading as did its predecessors.

and each year a vast number of engineers have arrived at that degree of maturity that they will be interested to read matter that constantly impresses them and seems to them new, but which in reality has already been largely well written long ago. The mature engineer will note that a large amount of technical literature is of the purely descriptive order, merely giving an outline of work that has been accomplished, without going into reasons or principles. Such reading is valuable and useful, but has its limitations. But this class of engineer will find a great deal of material available to himself, and the question arises what he shall do with material which he selects as important to him.

Several courses are open to him: First, he may rely on his memory and the published index to his bound volumes. It is probable, however, that few engineers make practical use of this method. Second, he may keep a special card index of important data and reference to valuable articles. This involves labor and attention which few busy men can give and which, if done by assistants or librarians, largely loses its personal value to the one who needs it. There is an objection to volume indexes that the bother of the search is so discouraging that it is abandoned in about one-half the suggested attempts. It is probably safe to say that of all the contrivances for indexing, the most difficult to handle readily and examine rapidly is the card index system. Third, he may abstract important data in a limited way on loose-leaf transparent paper, standard letter size, and he may remove or detach articles of special value from out his journals, to be filed in regular office file systems like correspondence.

The writer has tried all of the above methods at considerable cost in time and patience, and has for many years settled upon the third method above outlined. With all its admitted limitations, it seems to be the best for an office which is expected to find out information on a great variety of subjects in a limited time and with the least amount of effort. Some descriptions of its practical workings may be of interest here:

All the technical papers of the office pass on to the desk of the head of the office and are at least looked over (not read) by him. Articles important to his particular specialty are checked with pencil, and articles of especial interest are looked over with care and double checked. Once in a long while data important enough to go to the data file are noted. This is either especially abstracted by the stenographer, or, if a diagram or cost data, perhaps traced in the drafting room; all on transparent paper for copying purposes. Special data of this kind on 8½-inch by 11-inch sheets are filed on the office data file (a separate but common standard correspondence file). From the data file loose-leaf working notebooks are made up from blueprints for office or travel purposes. They are altered, refilled, amended and sorted back from time to time as needed to keep them of usable volume and usefully up-to-date.

The technical journals, with checked articles, go to the office clerk or the stenographer at odd hours, or the librarian if one can be afforded, and the useful articles are removed by tearing them out with a ruler. They are folded, usually once, to standard size, with one edge lap left for binding, and are then filed in a subject index file, like current correspondence. The Dewey decimal system, especially arranged for the office, is used, but only as a general subject plan. When the file is full, portions of its contents, especially that which is most useful, are simply bound in plain pasteboard covers and placed in the library shelves, with titles. Such a book (or many books) would contain all the recent articles thought to be of special value on a given single subject. The remaining portion of the technical paper is thrown away, but in a large office, warranting the expense, duplicate bound copies can be kept as well, with the general published index as their key.

The objections to this system are, that it is too expensive for any but the most important offices doing specialized work; that the data accumulate too fast unless rigidly kept down to a minimum, and that it requires some personal attention of the head of the office, a competent assistant or a regular librarian employed for the purpose. The advantages are that it compels the office head to know all the time what is being published in current engineering literature, if only by inspection; that it removes all intervening indexes between the searcher and the final repository in bound volumes; that it keeps one's library usefully up-to-date on all lines in which he should be especially interested, and it is economical of final shelf room and cost.

Obviously, one should not start so elaborate a system as this unless he is fairly sure of the special line of engineering to which his life will be devoted. It is not to be recommended to the young man, but only to the mature man of early middle life when his work thoroughly indicates the necessity for it. It is, however, absolutely essential to the specialist. Not a few consulting engineers use this standardized system interchangeably, particularly the data file, thereby greatly increasing its usefulness to each other as a joint effort.

To the mature and experienced engineer of advancing years, the technical journal again becomes a technical newspaper of great personal interest and deep satisfaction. He is now chiefly interested in the human, personal and ethical side of the work, and he realizes that, though he may have seemed to others and even to himself to have been striving all these years for emolument, as a matter of fact, the deep and abiding motive of his life work has been the pleasures of being needed and the joy of being useful.

Detailed comparisons of the cost of hauling by teams and motor trucks, made by the Chicago Municipal Market Commission, indicate that with the former the cost is 17¾ cents per ton-mile, while with the latter the cost is only 11¼ cents. It is estimated that two-thirds of the time is spent in loading, unloading and traffic delays.

The cause of the cracking of reinforced concrete when the reinforcing material discharges current into the concrete has been found to be the formation of rust upon the anode. In the report of the Committee on Electrolysis at the Atlantic City Convention of the International Association of Municipal Electricians, Mr. Leon Taylor, the chairman, stated, on the authority of the Bureau of Standards, that this formation of rust takes place only at temperatures around 100 deg. Fahr., and that damage to the concrete is therefore not to be expected unless the density of the discharge is very high, or some other conditions keep the concrete above the critical temperature. The addition of a fraction of 1 per cent. of salt to concrete increases its conductivity and destroys the passivity of the iron.

Suggested Design in Reinforced Concrete for Proposed Bloor Street Viaduct, Toronto

THE growth of the suburbs of the city of Toronto has created an urgent need for the development of transportation facilities across the Don River valley. This requirement is catered for by the linking of Bloor street with Danforth avenue by a viaduct which will accommodate the traffic of the northern portion of the city, avoiding a considerable detour and at the same time relieving congestion on the Queen and Gerrard street bridges, which take care of the traffic of the southern part of the city adjacent to the waterfront.

The project calls for the construction of two bridges, one approximately 1,600 ft. long, and another approximately 700 ft. long. The remainder of the work consists of grading the hillside. Tenders have been called for the construction of both bridges.

The character of the development of the district adjacent to this viaduct is a matter of great importance to the city, as the location forms a very desirable site for high-class residences. The adjoining district of Rosedale is occupied entirely by this type of residence and ranks high among the best residential districts of Toronto.

In such a district it is essential that the architectural features of the structure be given the closest consideration, as the expenditure of a fair sum of money in this direction will make many thousands of dollars' difference to the value of adjacent property and a proportionate difference to the city's revenue from that property.

There appears to be inadequate knowledge among engineers and the general public as to the development of reinforced concrete construction, especially relating to bridges

It is of interest to note that to the designs of one firm alone, 1744 bridges have been built over a period from the year 1895 to the year 1912.

Year	No. of Hennebique bridges erected
1895	3
1896	8
1897	14
1898	24
1899	41
1900	55
1901	64
1902	84
1903	96
1904	106
1905	132
1906	178
1907	168
1908	149
1909	160
1910	172
1911	168
1912	122
Grand total to end of 1912	1,744

These returns show clearly that there is no foundation for the idea that reinforced concrete bridge construction is still in an experimental stage. Moreover, considering for instance one bridge, the tests given below prove that the designers have achieved a high state of development and efficiency.

The Risorgimento Bridge over the Tiber at Rome was completed on the Hennebique system of ferro-concrete construction in May, 1911, and is now about three and one-half years old. It is 328 ft. clear span, 65 ft. wide over all, carrying ordinary roadway traffic and double electric car tracks. This is the longest span ferro-concrete bridge in the world.

Preliminary tests were conducted in April, 1911, with the following loads:—

Rolling load, 168 tons, consisting of seven steam rollers and a large tree trunk on a special wagon drawn by sixteen horses. This was an exhibit at the International Exhibition at Rome.

Deflection was as follows:—

	DEFLECTION		Proportion of Span.
	in Millimetres	Approx. equiv. in inches	
Crown of Arch.	3·5	9/64 ins	$\frac{1}{28,600}$

Official tests conducted May 8-11 under the supervision of a special commission, consisting of Commander-Engineer Ceradini, Director of the School of Engineers, Rome; Cavalier Guidi, Professor of the Course of Construction of the Polytechnic School, Turin; and Commander Engineer Rinaldi, Assistant Director of the Italian State Railways.

Test (a) One-half of the bridge (crown to springing) was loaded to 127 lbs. per square foot with deflection as follows:—

	DEFLECTION		Proportion of Span
(mean of three instruments)	in Millimetres	Approx equiv. in inches	
Crown of Arch.	13·1	33/64 ins.	$\frac{1}{7,634}$
Right hand haunch. ...	1·00	3/64 ins.	
Left hand haunch. ...	13·7	35/64 ins.	

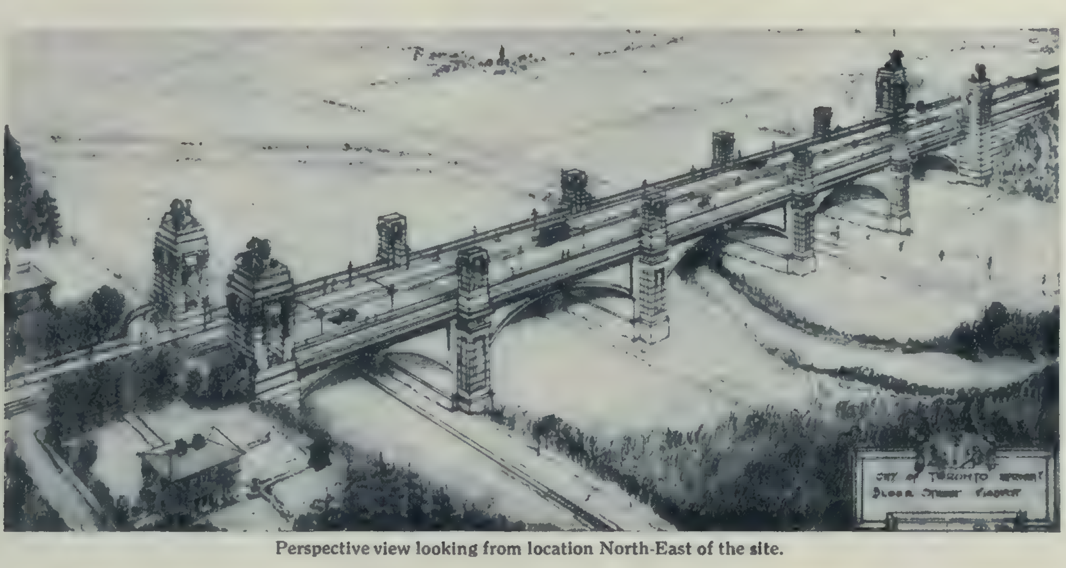
Test (b). The complete area of the bridge was loaded to 127 lbs. per square foot, the total load applied being approximately 1,370 tons.

Deflection was as follows:—

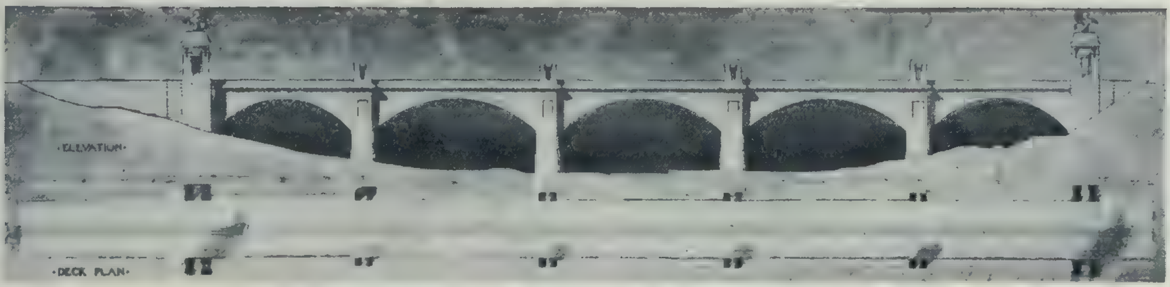
	DEFLECTION		Proportion of Span
	in Millimetres	Approx equiv. in inches	
Crown of Arch ...	32·2	1 17/64 ins	$\frac{1}{3,105}$
Right hand haunch ...	16·2	41/64 ins	
Left hand haunch. ...	19·1	3/4	

Test (c). Load of 127 lbs. per square foot retained on footpaths, and bridge traversed by three steam rollers abreast (total weight approximately 52 tons).

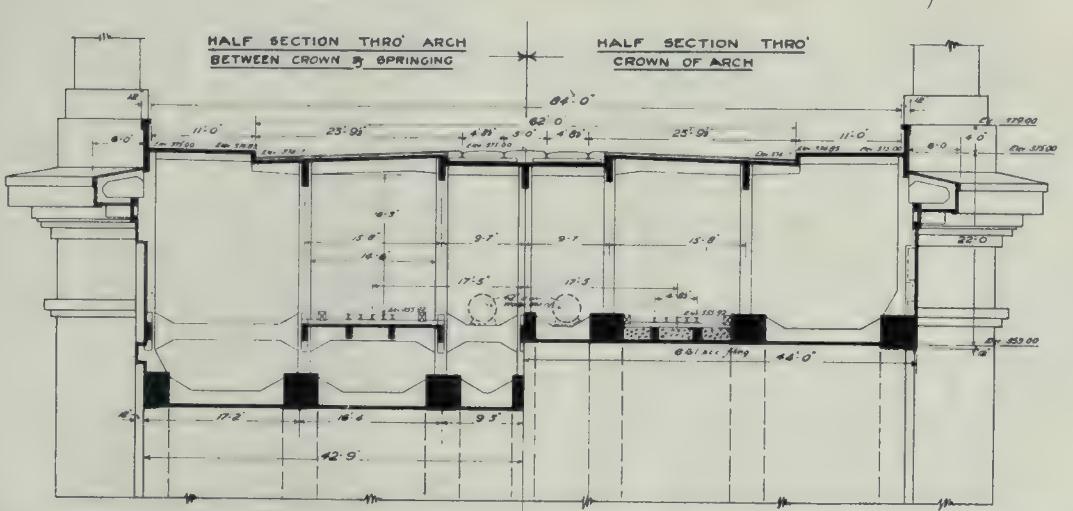
These road rollers were driven four times across the bridge in each direction, the instruments giving consistent diagrams, demonstrating the absolute elasticity of the construction and showing clearly the ab-



Perspective view looking from location North-East of the site.



True elevation and plan of viaduct drawn to scale showing architectural treatment.



Cross-section of the viaduct, showing elevation of pier and sections through the arches at crown and midway between crown and springing.

Suggested Design in Reinforced Concrete for the Proposed Bloor Street Viaduct, Toronto

sence of permanent deformation. The maximum deflections registered were as follows:—

	DEFLECTION		Proportion of Span
	in Millimetres	Approx. equiv. in inches.	
Crown of Arch ...	2·0	5/64 ins.	1/50,000
Right & Left haunches. ...	0·9	3/64 ins	

Test (d). Vibration tests were conducted on July 14, 1911. Companies of soldiers were marched across, the pace being increased until the maximum vibrations were obtained. With 1,100 men marching at "quick step" the maximum deflection registered at crown of arch was ·2 millimetres, = approximately 5/64ths of an inch, = 1/50,000 of the span. For the same number crossing the bridge at "the double" the maximum deflection was 2.5 millimetres, = approx. 7/64ths of an inch, = 1/40,000 of the span.

These figures are so striking that no comment is necessary.

Differences of temperature have much less effect on reinforced concrete construction than on a steel structure. It appears that the co-efficient of conductivity of steel is about thirty-three times that of reinforced concrete.

Reinforced concrete bridges have been constructed all over the world and have proved themselves capable of withstanding the severest climatic conditions.

We illustrate herewith the designs of Messrs. L. G. Mouchel & Partners, Limited (Hennebique Ferro-Concrete), for the Bloor Street Viaduct, Toronto. The contractors tendering on these designs were Messrs. William Cowlin & Sons, Toronto.

These views show fully the adaptability of reinforced concrete to the surroundings and the way in which it lends itself to architectural treatment.

The interesting feature of this design is that the subway tracks are entirely enclosed, reducing the effect of climatic conditions to a minimum. No snow or ice can lodge in the structure to add to the dead weight. The tracks, wiring, water and gas mains, etc., are housed within the structure and are readily accessible and protected.

Paints for Cement and Concrete Surfaces

Specially Contributed by H. B. Magowan

THE great number of uses to which Portland cement has been adapted in recent years, has created a persistent demand for paints suitable for decorating and waterproofing cement. The other methods involve the external application of substances to the cement after the manner of paints. The difficulty is to find a standard paint that will be suitable for all kinds of cement work, and at the same time be durable. If all cements were of the same chemical composition the problem could be easily solved, since the durability of the paint would be governed only by external conditions, such as moisture, smoke, salt, chemical fumes, and other atmospheric impurities. The chemical composition of cement, however, is by no means a constant factor, and the limitless variations in the physical and chemical constitution of cement mixtures, renders the standardization of cement paints almost impossible.

In order to understand the difficulty that faces the would-be painter of cement, it is necessary to know something of the chemical action that takes place when cement sets. The exact composition of Portland cement has not yet been determined, and consequently the reactions that take place when water is mixed with it can only be surmised.

Many researches have been undertaken to determine what takes place in the setting of cement, and whilst authorities differ on the subject, they are all agreed that Calcium Hydroxide is one of the resultant compounds.

The experiments conducted by the Russian chemist Liamin tend to show that calcium hydroxide to the extent of 3.2 per cent. is present in a crystalline state in cement seven days old. At the end of one year the same investigator found that the percentage of hydrated lime had increased to 32 per cent. These facts have a most important bearing upon the subject of cement paints.

The presence of lime in the cement is a disturbing factor in the durability of oil paints, for lime reacts upon the various oleaginous constituents, saponifying them, and forming a soap that is largely instrumental in hastening the distintegration of the pigments.

In order to combat the sponification of oils in paint a preliminary treatment, with the object of neutralizing the activity of the lime, has been tried out, with very successful results. One of the best-known of these treatments was suggested by Macnichol, and consists in the application of a 25 per cent. solution of zinc sulphate as an undercoat to the paint. When zinc sulphate is applied to cement chemical changes occur resulting in the formation of two inert substances, calcium sulphate and zinc hydroxide. The lime being now "killed" it is safe to apply good oil paints without fear of non-durability.

It is also claimed for the Macnichol process that cement can be successfully painted before it is thoroughly dried out, but such procedure would appear unwise.

Probably zinc oxide ground in pure linseed oil is the best single pigment paint that can be applied to cement, especially where the cement is exposed to the smoke of towns. The formation of sulphides causes the gradual blackening of lead paints, but since the sulphide of zinc is white the change from oxide to sulphide is not apparent.

In the North of Ireland, cement-coated houses are numerous, and experience has taught the owners that the best way to treat the exterior walls is to let them thoroughly dry out, before applying any protective materials. When once dry the cement is painted with pure boiled linseed oil, which darkens the appearance very considerably, but this dark appearance passes off in a short time. This preliminary treatment with oil serves two purposes: it renders the walls impervious to the moisture so prevalent in Ireland, and it neutralizes the lime. After one or two years the cement is in excellent condition for painting and two coats of good paint have been known to last many years without showing any lack of durability.

In Larne, Ireland, many of the better class houses are painted with red oxide of iron paint and the results have been most satisfactory, in some instances the paint appeared as good as new after years of exposure.

Many patent paints have been marketed with great promise of success, but the ideal paint has yet to be brought forward. Some of these paints contain resin, which is durable but unsatisfactory on account of its brittle nature.

Liquid hydrocarbons have been tried as a means of waterproofing cement, but the thin film of paraffin that covers the surface is not calculated to permanently resist the influence of moisture. Coal tar, asphaltum in solution, and various forms of pitch are utilized in other methods, but these substances, like resin, are too brittle and inelastic, and consequently very often fail to prove durable and weather-resisting.

One of the best suggestions advanced to protect cement from the elements is based upon the fact that the fatty materials in soap enter into chemical combination with the calcium hydroxide, forming calcium stearate, a waterproof compound.

In the Sylvester process the cement is treated with alternate coats of alum in solution, and soap. As the result of this treatment two compounds are formed—calcium stearate and aluminum hydroxide, both of which are capable of resisting water.

Attempts have also been made to utilize casein but it is entirely unsuited for the purpose, it being porous and apt to decompose in the presence of moisture.

Soluble silicates, such as sodium silicate (water glass) form the bases of other waterproofing compounds, the efficiency of these substances being due to the formation of mono silicate of sodium, a gelatinous precipitate that fills the surface irregularities of the cement.

The tendency of all recent research in cement work is to establish the fact that the best results in the painting of cement and concrete surfaces are obtained by the application of a priming coat of some efficient neutralizing agent such as zinc sulphate.

Individual experiments have sometimes led the builder to believe that paint will be quite permanent on dry cement without any preliminary treatment.

It is a simple precaution, however, to treat the surface with a solution of sulphate of zinc and it is better to be penny wise than pound foolish.

The Wielder of the Weapon

BREAKING away from the usual technical subjects, Prof. H. E. T. Haultain, of Toronto University, on November 5 read a paper, "The Wielder of the Weapon," at the monthly meeting of the Canadian Society of Civil Engineers, Montreal. This dealt with the status of the engineer, his relation to the public, and the need for more publicity as a means of raising the status. Professor Haultain contrasted the position of other professional men, such as lawyers and doctors, with that of the engineer, the former being more in the public eye by reason of the nature of their work. To-day the engineer was forcing the conveniences of man from nature. His weapons were science, and the wielding was his own, but he was so engrossed in his work of getting results that the public valued the outcome without recognizing the man who brought them forth.

This modesty of the engineers, Prof. Haultain said, extended even to their speech and dress. The engineer talked in blue prints and specifications, while his dress was fitted for hard work rather than for telling the public what sort of a man he was. The law had its spectacular trappings and oratory, while soldiers advertised themselves with gold lace, feathers and uniforms. But the engineers, who were doing much more useful constructive work, had no such means of advertising.

As to publicity, he admitted that this was a difficult matter, but argued that a paper publicity, which would educate the public to a better appreciation of the engineer, would be a great help to the younger men entering the profession. The real problem was to find suitable publicity. As one means he suggested the passing of legislation compelling municipal engineering work to be done by engineers of a certain standing, while the publication of a code of ethics might aid.

In this matter, he said, they must emphasize the man, the wielder of the weapon, who did not use the products of science for exhibition purposes, but turned them to practical use. The men who could do this were as worthy of high places as the men who could make the weapons, no matter how beautiful they might be. This wielding of the weapon of science, as applied to the needs of mankind, was so new and growing so rapidly that no one had a comprehensive view of it, and he left it with his auditors whether the engineer did not need some higher approval from his fellow-men.

In the discussion which followed, there was almost unanimous approval of the views of Prof. Haultain. It was pointed out that this was a very old subject, but none the less it was of great importance to the profession.

The President, Mr. M. J. Butler, emphasized the point that engineers did not occupy the position in the public eye that they were entitled to, and it was, he felt, largely their own fault. Men had been striving after the dollar, but as the result of this war it was probable that better ideals would prevail in the near future.

Mr. W. J. Francis spoke of the indignities that some of their members had suffered at the hands of municipalities, and suggested that this subject might be taken up by the Society. Mr. Francis alluded to the practice of many young men fresh from college setting up as consulting engineers, a practice which he believed was detrimental to the profession. He also condemned the idea of engineers competing for work, and alluded with approval to a circular issued by the Institute of Civil Engineers, London, strongly objecting to this method of employing engineers.

Mr. Julian C. Smith said that engineers should discuss Government and municipal schemes before these schemes were put into operation. He believed that this would be to the advantage of the public. Many engineers were employed by corporations, and from the nature of their work it was inevitable that these engineers should not be largely before the public.

Messrs. R. A. Ross, C. A. Fraser, J. Fairbairn, R. F. Uniacke, and Dr. Porter also took part in the discussion.

The spandrel or face walls of a concrete arch may be carried up at the same time as the arch ring is laid, or may be connected with it later by leaving short lengths of steel projecting radially from the concrete of the arch. Some engineers require that arch centering shall be lowered sufficiently to allow the arch ring to assume its permanent set before parapet walls are placed.

The Functions of a Municipal Engineer

The More Important Duties Outlined, Particularly in Reference to Water-Works Engineering—Use of Reinforced Concrete in Reservoir Construction

By Prof. E. R. Matthews[†]

NO branch of engineering is more important than that connected with municipal work, and the position of engineer to a corporation is becoming more responsible every year. I believe the time is fast approaching when the municipal engineer will be an official who will reap the advantages of a pension, and who will be given "security of tenure" by the Government. On the other hand, the time has arrived when no one should be allowed to hold an appointment as municipal engineer to a corporation (who has not hitherto done so) unless he can show that he has had a theoretical training as well as practical experience.

Chief Duties of a Municipality

Whether coast or inland town, the chief duties of a municipality are:—

(1) To supply pure water for the use of its inhabitants.

(2) To provide a proper sewerage system with sewage disposal works.

(3) To construct suitable streets and highways, and to maintain these.

(4) In many towns to put down and maintain a tramway system.

(5) To adopt a proper method of collecting and disposing of house refuse.

(6) To establish a satisfactory system of street lighting.

In addition to these and many other duties which he has to perform, the municipal engineer has now to prepare for his corporation town planning schemes, and in preparing these he must be able to look ahead, chiefly from an engineering point of view, and to anticipate the requirements of the town, say, twenty to thirty years hence. He will therefore have to be a man who dreams dreams and sees visions. But, in preparing a town planning scheme, I certainly think that he should work in conjunction with an architect, for, after all, town planning is more of an architectural matter than an engineering. The Institution of Municipal and County Engineers have recently decided to grant a certificate or diploma in "Town Planning," which is to be obtained by examination. This is a step in the right direction.

The introduction of reinforced concrete in engineering construction makes it very necessary that he shall be acquainted with this material, and understand how to calculate the strength of it under various conditions.

It is also extremely necessary that the municipal engineer should have a thorough knowledge of building construction, for while he must not claim to be an architect—for that is not his profession, and my experience has been that the man who is a good architect is a poor engineer—nevertheless, he will usually be responsible for the inspection of new buildings. He will often have to advise his council as to whether or not a rolled steel joist of a certain section will be sufficiently strong to carry a wall that is to rest upon it, or upon some other equally important point, and it will frequently happen that he will have to settle a dispute between an architect and a contractor relative to the strength of some part of a structure..

Chief Duties of Municipal Engineers

It will be quite impossible for us to deal with the manifold phases of a municipal engineer's work, which I have named. We will therefore confine our attention to the chief duties of a municipality as already set out, and discuss two or three matters which come under one or other of these heads.

"Scientific" Street Watering

That the ordinary humdrum task of street watering may be carried out scientifically may seem a somewhat remote possibility, but this is not so. It is painful to observe the waste of water and labor which occurs in the usual methods adopted in street watering. Take a concrete case. Here is an ordinary macadam road, 38 ft. wide. The water cart with its spreaders is able to water a width of road each time of, say, 16 ft. Assume that the old-fashioned spreaders are in use, which do not admit of one side being shut off and the other only in operation; the result is that, to water the road the full width of 38 ft., the water cart must pass over the road three times. But 16 x 3 equals 48, and all we require to water is 38 ft.; therefore 10 ft. of the road is watered needlessly. Water is thus wasted and labor, and the use of the horse, which might have been otherwise employed. The method I have adopted in watering a road, say, of that width, is to water the sides of the road, including the channels, and to leave the centre of the road. I find that the dust on a road does not accumulate in the centre, but blows towards the channels, and this is where the watering is needed. The centre strip of the road need not, indeed, be watered. The Westminster City Council, I notice, are using a very useful motor vehicle in the shape of a cylindrical water cart, which probably holds 1,000 or more gallons of water, and this vehicle flushes the channels of the road in a very rapid way. I advocate the use of such.

I now propose to deal briefly with another branch of municipal engineering—namely, waterworks engineering.

Use of Reinforced Concrete in Reservoir Construction

First let me set out some of the advantages of using this material.

There is a growing tendency on the part of engineers, especially in America and on the Continent of Europe, to construct service reservoirs in reinforced concrete. A notable example of this may be quoted in the case of the new reservoir recently constructed at San Francisco. Mr. Shaughnessy, the city engineer of San Francisco, has—wisely, I think—used reinforced concrete in the construction of this reservoir. The advantages of using this material for this purpose are many:—

(a) There is a saving in first cost.

(b) A reservoir built in this material occupies less

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[*] Abstract of an Address delivered at University College, London.

[†] Professor of Municipal Engineering in the University of London.

space than one constructed in masonry or brickwork, or a combination of both.

(c) It can more easily be made watertight.

(d) It increases in strength with age.

(e) There is less likely to be vegetation upon the face of the walls.

(f) Practically no cost in maintenance.

Circular vs Rectangular Reservoirs

In the United States most of the modern reservoirs are circular in plan. Reservoirs of this shape are seldom constructed in this country, British engineers preferring a rectangular structure. I recommend the circular shape, the chief advantage being that when of this shape no angles occur, so that the reservoir wall can be built without a joint. This is a great advantage, for one often finds that when leakage occurs in a reservoir it can be traced to the point where the walls join. Circular reservoirs, because of their circular form, are also better adapted to withstand external earth pressure; they are cheaper than rectangular ones.

The San Francisco new reservoir previously referred to is a good illustration of the circular type of reservoir. This may be briefly described as follows:—

The reservoir was completed about two years ago. It is known as the "Twin Peaks" reservoir, and is a good example of what may be done in reinforced concrete. It is oval in plan, and divided into two parts by a reinforced-concrete dam. The reservoir is situated 750 ft. above the business section of the city, and is part of the high-pressure system for fire-extinguishing purposes established in consequence of the terrible fire of 1906. The dimensions of this reservoir are 370 ft. by 25 ft. 8 in. area, and the depth of water allowed for is 27 ft., or a capacity of 11,000,000 gallons. The buttresses of the dam are spaced at 9-ft. centres on both sides of the wall. They are 1 ft. in thickness, and 13 ft. wide at the base.

Watertight Reservoirs

Referring to the leakage of reservoirs, we would say that this is a problem which has engaged the serious attention of engineers for many years past. Reservoirs have been constructed in what appeared to be a substantial manner, on a good foundation, and at a cost of many thousands of pounds, but they have never ceased to leak, and while many attempts at remedying the leakage have been made, these constructions are looked upon, from an engineering point of view, as a failure.

I know of no type of reservoir, however, which is more likely to be watertight than that constructed of reinforced concrete, provided the reservoir is properly constructed and expansion joints are inserted in suitable positions both in the walls and floor of the reservoir, and if suitable material is used for the concrete, and the walls are not less than a minimum thickness of 5 in., and are well reinforced, and that the depth of water in the reservoir does not exceed, say, 30 ft.

The thickness of the floor will depend entirely upon the sub-foundation. This floor may be either of plain or reinforced concrete; if the latter and the sub-foundation is good, the thickness of floor should not be less than 6 in. for a depth of water up to 15 ft., and 9 in. for a depth ranging from 15 ft. to 25 ft., and 12 in. from 25 ft. to, say, 35 ft. In every case it is assumed that the floor is well reinforced. In order that the reservoir may be watertight, in addition to the before-named precautions, great care must be taken as to the properties used in the concrete. I would suggest that never should a weaker mixture be used than 1:2:4, and where the depth of water to be stored is not less than, say, 20 ft., I would recommend a mixture of 1:1½:3. The materials should be very carefully graded, as most of the trouble in reservoir work occurs where this has been imperfectly done.

I also recommend for reservoir work that a wet mixture shall always be used, and while a dry mixture may show a better result as regards its strength in compression, and a plastic mixture may also give better results in this way, still a wet mixture more perfectly prevents leakage, and on that account should always be used.

Not only so, but with a wet mixture the reinforcement is better covered. I have seen reinforced-concrete work where a fairly dry mixture had been used, and where occasion had arisen for the breaking up of the concrete, where the reinforcement in places had not been covered in the least degree by the concrete. This had occurred, first, because the mixture was too dry, and, secondly, because the aggregate used was too large. In practice the concrete should be of such a consistency that every portion of the reinforcement will be well covered, and every crevice filled.

Not only is this obtained by using a wet mixture, but with such a mixture when the forms are removed there is a smooth face to the concrete, and on this account also it is wise that the mixture should be fairly wet. Care, however, must be taken to see that it is not too wet. It is possible for too large a quantity of water to be added so that the grout will run through the joints in the forms, and escape from the wall; on no account should this occur. If reservoir walls are constructed with a mixture of 1:2:4, the ultimate strength of this concrete, assuming well-graded stone and sharp sand is used as the aggregate, will be about 2,000 lb./in.^{2} at the termination of one month, and 2,700 lb./in.^{2} at the end of six months. The usual working stress for good concrete is taken at 600 lb./in.^{2}. Under exceptional circumstances, however, this may be reduced to, say, 500 lb./in.^{2}, but I would recommend, generally speaking, for reservoir work 600 lb./in.^{2}.

Reservoir Piers

These are sometimes built circular in plan, and there is a slight saving in the space occupied by so doing. It is, however, more costly to construct the forms in this shape, and the advantage of saving in space does not really compensate for the increased cost. The usual practice in this country is to build rectangular piers, and to chamfer the edges, say, with a 1½-in. chamfer to a 10-in. or 12-in. square pier. The square pier has the advantage also that it affords a better seat for the reinforced-concrete beams carrying the roof to rest upon.

Reservoir Roofs

In reinforced-concrete reservoirs this usually consists of a reinforced-concrete slab, 5 in. or 6 in. in thickness, carried by reinforced-concrete beams which rest on the piers just referred to. Some engineers prefer a lighter slab, and to ensure this they introduce a system of secondary beams. For my own part I do not care for the roof slab to be of greater thickness than 6 in.; 5 in. is preferable, and the beams can be designed accordingly. In calculating the weight of the roof it is necessary to include the weight of concrete and reinforcement forming the beams and slabs, also to allow for any soil which may be spread on the roof. This is usually about 1 ft. or 18 in. in thickness, also to assume a thickness of snow of, say, 2 ft. It is necessary to construct two or three openings in the roof for the purpose of getting to the inside of the reservoir, and iron ladders are usually built in at these points. The openings need not be larger than 6 ft. by 3 ft.

Cement Grouting

It is always advisable after short sections of the work have been completed to wash the walls over with two coats of cement grout, 1 to 1 (sand and cement). This fills in any slight cracks which may have occurred on the suface of the concrete. A fortnight should elapse before the grout is applied. No further cracks on the surface of the concrete will be likely to occur.

Wetting Concrete

If the reservoir is being built during the summer months, when the sun is likely to dry the surface of the concrete very rapidly, the latter should be frequently wetted so as to retard the drying action of the sun. It is also advisable to do this in high winds.

Size of Aggregate

In reservoir work the aggregate used in the construction of the walls, floor, piers and beams of the reservoir should be capable of passing through a ¾-in. ring; for the roof slabs it should be capable of passing through a ½-in. ring.

Where the thickness of the concrete floor exceeds 9 in. the aggregate should be capable of passing through a 1-in. ring, the upper 4 in. of the concrete in the floor should consist of concrete, the aggregate of which is capable of passing through a ¾-in. ring.

Reinforcement

It is not my intention to advocate any particular system of reinforcement. There are many in the market, and most of them are good, and I say this after having used several different systems myself. It is quite possible, however, and I strongly advise you to adopt this course, for the municipal engineer to work out his own stresses and design his own system of reinforcement.

Thickness of Walls

For heads up to 10 ft. a 5-in. wall will generally be found to be sufficient; a 4-in. will answer, but I prefer a minimum thickness of wall of 5 in. It has, however, been suggested that the walls should be increased in thickness for every additional 5 ft. increase in head of pressure. I agree with this suggestion, but prefer that the top 6 ft. of the reservoir wall shall be 5 in. in thickness, and that the wall shall be increased in thickness by 2 in. for every additional 6 ft. of its height.

It is usually desirable to build counterforts or buttresses at the back of the wall.

There is a saving of from 20 to 25 per cent. by using reinforced concrete in the construction of reservoirs. Some engineers recommend that the water face of reservoir walls shall be rendered with 1 to 1 cement mortar to a thickness of ½ in. or ¾ in., but I do not favor this; I think it is unnecessary.

Stresses

The elongation of steel being so much greater than that of concrete, it is advisable, in order to ensure of the reserevoir being watertight, to limit the stress to 12,000 lb./in.^{2}, and I think it is advisable in reservoir work to use bars which give a mechanical bond, such as the indented bar, twisted bar, lug bar, or one of the other various types of bars, rather than plain bars, but this only applies to reservoir work, as plain bars are admirable for all other reinforced concrete work.

It is necessary that an adequate percentage of steel be inserted in the concrete in both directions, even when the stresses due to water pressure occur in one direction only, or otherwise slight cracks may occur.

Reservoirs may be—

(a) Entirely sunk below ground.

(b) Partly sunk below ground.

(c) Out of ground.

(a) **Reservoirs sunk below ground.**—On designing the first type we must remember that the reservoir may be full or empty. When empty the walls will be acting as retaining walls with all the pressure at the back; when the reservoir is full there is still the pressure of the soil at the back of the walls, but counteracting this is the water pressure from within. It is therefore desirable that walls of this class shall have reinforcement on both sides, and not in the centre of the wall, as had the reservoir which failed at Mittagong, N.S.W., as we shall see presently when considering that failure.

(b) **Reservoir partly out of ground.**—These are known as the cantilever type. In determining the width of the heel we must remember that in an ordinary retaining wall the weight of the earth at the back of the wall would help to keep the wall from overturning, but with a reservoir the weight of the water should be disregarded. The heel should therefore be made of sufficient width and thickness to be stable when the weight of water above it is neglected. One of the most important things to be careful with in designing a reinforced-concrete reservoir is the arrangement of the bars at the joint between the vertical wall and the footing.

(c) **Reservoirs out of ground.**—These will be similar in design, but buttresses are usually added. The wall acts as a dam to withstand water pressure.

Reservoir Roof

This often acts as a tie, and holds the reservoir walls together; the reinforcement is therefore arranged accordingly. When the span is large, however, the elongation may be considerable, and it is then not advisable to tie the walls in this way, but to give the roof free sides for expansion.

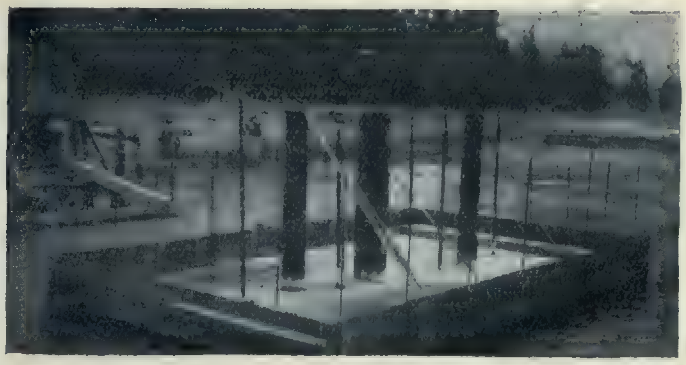
Engineers who are not in favor of the use of reinforced concrete are very ready to draw our attention to this failure; but this is unfair, for the reasons why the structure failed are quite clear, as we shall see in a moment.

We can always learn more from failures than from successes. This reservoir was 40 ft. diameter, and was built in connection with the water supply of Mittagong, N.S.W. It burst on January 22, 1909. It contained 32 ft. of water at the time of bursting. Once before it had been filled to a depth of 33 ft. 9 in. The reservoir was constructed on a solid rock foundation in an old quarry excavated 7 ft. deep on top of a steep hill, and when the structure burst the 240,000 gallons of water which it contained rushed down the slope; no damage was done, however. The lower half of the reservoir failed all round simultaneously; the upper half then collapsed.

The floor of the reservoir was 12 in. thick, and of plain concrete.

Design: Capacity of reservoir, 314,000 gallons; 40 ft. deep to top of water level; shell of reinforced concrete, 4½ in. thick under coping, 10½ in. thick at bottom of wall, including ½ in. of rendering on inner face, and ¼ in. on the outer surface.

Launching caisson No. 2, Fraser River Bridge.



Caisson No. 2 immediately after launching.

An Expeditious Bridge Contract in British Columbia

(Staff Article)

THERE was recently completed at Hope, B.C., for the Kettle Valley Railway Company, the substructure of a bridge across the Fraser River which on account of the rapidity of its construction merits somewhat more than passing mention. The substructure consists of three river piers and two abutments, and the finished quantities of concrete amounted to 9,300 cubic yards. The river piers were put down by the pneumatic process, the caissons being of timber construction with steel cutting edges and of the following sizes: Pier number 1, 25 feet x 5 1feet 6 inches; piers numbers 2 and 3, 29 feet x 51 feet 6 inches. The cribs were of 12 x 12-inch timber throughout. Each caisson was equipped with two muck locks and one man lock. The shafts were roughly boxed in from about 10 feet above the deck of the caisson and recovered after sealing. The pier shafts were nine feet under the coping with uniform batter of 1 in 15, semicircular ends being struck from centres 28 feet 8 inches apart. The coping was three feet in depth. The superstructure will consist of four spans each 238 feet long with provision for a roadway above. Ground was broken in November, 1913, and the whole work was completed early the following May. About 160 workmen were employed on an average during the progress of operations. Following are details of the pier construction.

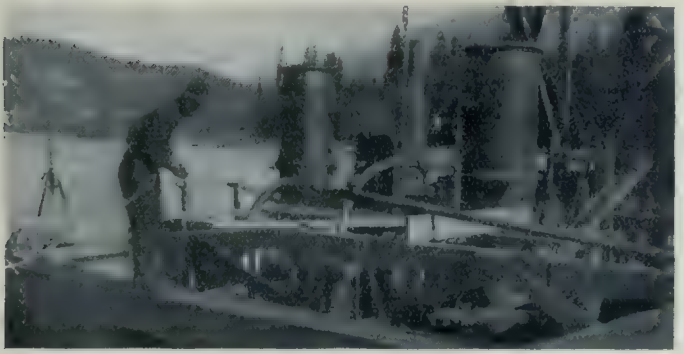
Number of pier.	Depth of water.	Penetration.	Material.	Av. rate of sinking per 24 hours.
1	10 ft.	30 ft.	Gravel & Sand	1.74 ft.
2	35 ft.	30 ft.	Gravel & Boulders	1.45 ft.
3	35 ft.	8 ft.	Rock (sloping surface)	0.46 ft.

The compressor plant consisted of three 60 h.p. loco type boilers, two Canadian Rand compressors, 14-inch x 18-inch x 18-inch direct acting, with receivers for supplying air to the working chamber and one Ingersoll Sergeant compressor, 12 inch x 18 inch, high pressure for rivetting, boring, driving drift boats, etc. There were also a scow and overreach divers as well as two concrete mixers. The usual accompaniment of derricks, cars, etc., completed the plant.

Housing accommodation for the working force consisted of four bunk-houses each occupied by twenty-four workmen, one bunk-house accommodating fifteen men, an office and kitchen camp with dining room accommodation for one hundred men.

When it is considered that 300 feet of falsework was carried away by the ice, that delay was occasioned at pier number 2 by a strike of sandhogs, and that from April 5th, when the river began to rise, until the end of the work when the total rise exceeded 8 feet, considerably extending operations, the completion of the work before high water reflects great credit on the contractors, Messrs. Armstrong, Morrison & Company, of Vancouver. This work was under the direction of Mr. A. McCulloch, M. Can. Soc. C. E., Chief Engineer of the Kettle Valley Railway, with Mr. F. Pardoe Wilson, M. Can. Soc. C. E., as Resident Engineer in the field.

The annual meeting of the Canadian National Clay Products Association opens at the King Edward Hotel, Toronto, on January 26 next. The Secretary is Mr. G. C. Keith, 32 Colborne Street, Toronto.



View of muck locks on caisson No. 2, showing arrangement of piping previous to the erection of working platforms.

Fraser River Bridge. View from north-east at the completion of the work.

The Construction of the Canadian Northern Pacific Railway*

By J. V. Nimmo

FOR a railway passing through one of the main mountain regions of the world, the work is on the whole, extremely light. From Port Mann to Rosedale, mile 47, the grading is largely prairie work, although spurs from the main mountain range give rise to heavier work at intervals. From Rosedale to Hope, mile 77, the work becomes heavier as the valley narrows, and stil more so from Hope to Yale, mile 91, but so far there is nothing calling for special comment. At Yale, the canyon proper is entered, and the heaviest work on the whole railway is encountered, the heaviest mile cost $326,300, without fence, telegraph or track. From Yale to Boston Bar, a distance of 26 miles, the rock work is extremely heavy, and there are 15 rock tunnels, aggregating 8,321 ft. The rock is mostly granite, and bluff follows bluff, all with almost perpendicular faces. A great deal of this rock was shot into the river, but a surprising number of fills were successfully constructed. As the rock was largely in huge masses, partly owing to its rough nature, and partly owing to the fact that it was often separated into large blocks by natural seams, these fills are well calculated to stand even the Fraser floods. This piece of line was perhaps the most difficult one to locate and cross section.

Character and Incidents of Work

From Boston Bar eastwards, gravel is frequently encountered; indeed, from mile 128 to Savona, mile 218, there is almost more steam shovel work than anything else. The heaviest yardage is in the neighborhood of Tilton Creek, mile 130. Here cuttings aggregating 414,000 cu. yds., were led to one large fill. Jackass Mt., extending from mile 130 to 134.5, consists of massive conglomerate and shale; the yardage for this half mile was 182,000 cu. yds., with two tunnels aggregating 548 ft. One of these tunnels was, however, carried out in an enormous slide in the hill side on the night of November 18th, 1912, following a period of heavy rain about six weeks after the tunnel was finished. The formation through which the tunnel was driven was very broken. A large black shale seam about two feet wide, which made an angle of about twenty degrees with the vertical, and thirty degrees with the centre line of the tunnel, crossed the line of the tunnel about one-third way through from the east end, separating the country rock on the up-side from an overlying rock formation on the other. This overlying material was very broken, and interspersed with soft clay. It seemed to be debris from the mountain side above and bore no relation to the country rock. Whether the hill slid on the shale seam, or whether the clay, swollen by the heavy rains, exerted excessive pressure on the tunnel timbers causing them to collapse, thus releasing the toe of the hill, it is impossible to say. The whole slide had been removed, and the hill side dressed to an apparently safe slope, when three weeks later, on August 25th, 1913, another slide of considerable magnitude occurred. This was in turn removed, and the slope re-dressed, leaving now an open cutting, probably safer than any other part of the mountain. The line crosses the Fraser at Cisco to follow the north or left hand bank, thus avoiding the Canadian Pacific. It re-crosses again at Lytton, and three-quarters of a mile further on, crosses the mouth of the Thompson River, since it was considered less costly to build these two crossings, than one large one across the Fraser, above the mouth of the Thompson.

A piece of heavy work is met with at Gladwin's Bluffs at mile 149 to 151. This is a contact zone between the Coast Range Batholith and the Paleozoic schistose rocks, the whole traversed by many tertiary dykes and chonolithic intrusions. It is a particularly awkward place on which to locate. The quantities for this two miles of work are as follows:—478,946 cu. yds. of excavation and 990 lineal feet of tunnel. The average cost per mile is $222,650, without track, telegraph or fence. Just beyond the Gladwin Bluffs, the line is constructed along the top of a rock cliff and at the foot of immense gravel slopes, which rise at an angle of between 1¼ and 1½ to 1, to a height of some 700 feet. This gravel, which was well cemented, was excavated by the hydraulic method, excess roadbed width being allowed, depending on the height of the face. The faces have stood splendidly, although the debris naturally accumulates at the foot of the slope, but not to a greater extent than such maintenance forces as must necessarily be employed by a railway through such mountainous country will be able to cope with. Bad bluffs were encountered at Thompson and Drynoch.

The rock at Thompson was even more broken than that at Gladwin, and a huge slide has occurred which is still being removed. At mile 162 there is a heavy clay slide, which is still moving, although 350,000 cu. yds. have been removed to date. There is no evidence of water seepage and there is nothing to do but keep on excavating, until the material reaches its angle of repose. Drynoch Bluff, mile 163, was a most dangerous place on which to locate, and offered the usual difficulties in construction. It has three short tunnels and the open slope is very high, surmounted by a good deal of gravel and other debris. Crib traps have been installed at various points on this slope to catch this debris, but here, as in other places, constant watch must be kept by the maintenance organization. At mile 184 the line crosses on to the C. P. R. side of the Thompson River and re-crosses at mile 188.5, passing direct from the bridge into a tunnel 1,319 feet long in the famous Black Canyon. This formation is a black cretaceous shale and sandstone. Just east of this tunnel there is a slide similar to the one on the C. P. R. side west of their Black Canyon. A spring, which made its appearance about one-third of the way down the slide, was tapped by a water tunel and led to an adjacent gully. At every high water, however, the slide moves and has moved for some one hundred and twenty feet since the records were first taken. It is thought that this is due partly to saturation from the melting snow, and partly from the action of the high water in the river, although what happens exactly is not yet understood. Borings showed 26 feet of clay and then gravel, but they were not taken down through the gravel. Some two miles further east the grade was first constructed at the foot of the bluff, partly in cut and partly in fill, the latter standing well until the flood of 1913. An extensive crib is now being constructed at this place. From Ashcroft, mile 194, to Savona, mile 218, it is almost all steam shovel work in glacial clay. Rock work is again encountered along Kamloops Lake, including a tunnel at Battle Bluffs 2,835 feet long. At mile 244, the line crosses to the east bank of the North Thompson; immediately east of the bridge is the Kamloops Division yard. Between Lytton and Kamloops there are three crossings and re-crossings of the Thompson River, to avoid heavy clay bluffs; the work on the Canadian Pacific side at these places being generally very light. From Kamloops Junction, mile 243, to Birch Island, mile 324, the work is easy on the whole, although occasionally the line hits a rock slope with some severity. From Birch Island to the third crossing of the Thompson River at mile 339, there is heavy steam shovel work along the supported grade. From mile 330 to the fourth crossing at mile 351, although the work was largely steam shovel material, it was entirely carried out by hand, owing to the difficulty of getting in machinery.

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*Transactions Canadian Society of Civil Engineers.

There is little to call for comment from here on, except to refer to the extraordinarily light work across Stillwater flats, until the supported grade between miles 360 and 376 (Canoe Landing) is reached. This is the heaviest portion of the North Thompson River work, particularly at Hell's Gate, where the river passes through a miniature Fraser Canyon, involving heavy rock cutting and two small tunnels. From mile 376 to the next supported grade at mile 406, the work is extraordinarily light for a mountain railway. From mile 406 to 417 extends a region of heavy sand, gravel and clay cuttings, and tunnels, one of these latter being 1,000 feet long. All this work is done by hand as it is not practicable to take in machinery. From mile 417 to the Albreda Summit the work is again very light, indeed at the summit itself it would be cheap for prairie country.

Crossing North Thompson River

The two crossings and re-crossings of the North Thompson are to avoid heavy work, and to get better alignment. The first two of these crossings are 80-foot deck plate girders, supported on pile piers, consisting of a group of 32 piles, capped by a three course grillage of 12 by 12 timbers. This in turn is topped by a one-inch steel plate bored to receive the anchor bolts from the girder bearings. Placed about the piling is a timber crib, pointed on the up stream and square on the other end. These cribs are not attached to the piling, but form a sleeve, and are sufficiently free of the piling to permit their sinking as they are built up from the water surface. The tops are completed to about five feet above high water and then are rock filled. The third crossing is a temporary pile bridge below the permanent crossing, which will be of concrete piers. The other two crossings are low and short, and are over wooden pile bridges. From mile 425 to Canoe River Crossing at mile 436, the rock work is fairly heavy, although there are a good many gravel cuttings also. Canoe River is crossed on a steel viaduct. From this point to mile 445, the work would be light even on the prairies. No really heavy work is encountered until the Fraser Valley is entered at mile 453. From this point the Grand Trunk is paralleled and the two roads are never more than a few hundred yards apart.

From mile 456 to Moose Lake, mile 472, there are some very heavy rock cuttings. Difficulties were particularly great for the last ten of these miles, owing to the fact that the grade had to be constructed immediately above the Grand Trunk, then in operation. The two lines run on the north shore of Moose Lake side by side as double track. From Moose Lake the Grand Trunk falls with a one per cent., and the Canadian Northern with a seven-tenths compensated grade. Hence the two lines rapidly diverge in elevation but remain very close in alignment. All mucking over this portion, from the Canadian Northern had to be carried across the Grand Trunk on trestles and shot direct into the Fraser River. Six of these trestles and chutes were constructed. From Moose Lake to Yellowhead, the work calls for no special comment, as it is light, and the valley wide and uniform enough to provide an easy route for both railways.

There is not much in this work of interest to railway engineers, except, (1) the bridging; (2) the steam shovel work in gravel and clay, and the resulting slopes; (3) the rock blasting; (4) the classification. (1) With regard to steel bridges: As these were designed and entirely under the supervision of Messrs. Waddell & Harrington, consulting engineers, the author does not propose to make any reference to them, beyond showing some views, in the hope that a paper will be read some day before the Society by a member of Messrs. Waddell & Harrington's firm. (2) The steam shovel work in gravel and clay, and the resulting slopes. No one would deny the value of steam shovels, or their necessity, if such work as is now being described, is to be carried on economically and expeditiously. At the same time, the engineer would be delighted to dispense with them, were that possible, unless the material were being excavated to a final angle of repose. In some cases this was done, but speaking generally, such a plan is a counsel of perfection, and not economically practicable. The difference in yardage between 1:1 slopes and 1½: 1 slopes on side hills that extend upwards for hundreds of feet is self evident. Moreover, in most gravel cuttings, a 1:1 slope, if not permanent, would give very little trouble for a number of years, when it can be economically handled by steam shovels with main line equipment. But when 1:1 quantities are dug by steam shovel and the slopes left standing nearly plumb, it means that the company has frequently to face comparatively heavy further excavation expenditure after the line is opened. Sometimes a portion of the slopes in steam shovel work was lightened by having the top hand sloped; but in the more cemented gravels and harder clays, the slope was left as dug by the steam shovels.

Undoubtedly, all things being equal, unless the quantities to be excavated in the first instance are those contained by slopes at the angle of repose, hand slope work is infinitely more satisfactory than steam shovel work. Most of the gravel and clay lies in the dry belt, otherwise it may be supposed there would be little left. Hence the conditions on this construction were unusually favorable for the safety of undressed slopes. (3) One of the main difficulties the railway engineer encounters is to prevent the contractor from using too much powder. Such work as is here described is usually carried out by station-men working under sub, or sub-sub-contractors of the main contracting company. The stationman, who seems to live in a state of perpetual hope, is strongly tempted to overshoot, with a view to breaking up his rock as small as possible, and to save handling, where, as was largely the case on this work, the material was wasted direct into the river, whose course the railway is following. That this may result in over-break, the stationman is well aware; but his faith and hope in the engineer's charity, will induce him to chance the disallowing of the over-break. If allowed, he stands to gain heavily.

Besides, there are seams which with a little flattery and talk about the experience of the engineer, etc., etc., he may hope to pass off as the cause of the overbreak. Indeed, the engineer will often be in a quandary to know whether the rock, even though lightly shot, would not have broken to a clearly indicated seam. The sub-contractor has little inducement to check the stationman from over-shooting for the more powder the stationman uses, the more profit the subcontractor stands to make. If no more than the estimated yardage is paid for, the sub-contractor makes at least as much profit as he set out to make and if overbreak is included, he is that much to the good. Thus with blarney and bluster, pressure is brought to bear on the engineer on all sides, which it is frequently very hard to resist, especially by the younger members of the profession.

Our Society excludes in its Standard Specifications the use of powder in large blasts in seams, drifts, shafts and coyote holes. This again is merely a counsel of perfection, nor would its strict enforcement tend to economy. The remedy must always be in the judgment and experience of the engineer in charge, who should make a point of at once warning the contractor against the results of heavy shooting, as soon as he sees any signs of such a course being proceeded with, and hold him strictly to account if his warnings and instructions are neglected. From the experience of this work, the author is strengthened in his convictions that more than from a pound to a pound and a quarter of explosive to a cubic yard of excavation is needed only in very rare cases; and in ordinary sandstone and limestone, if at all seamed, three-quarters of a pound per yard would generally be sufficient. For shales, half a pound or less is plenty. (4) Classification. From Port Mann to Hope, and from Kamloops to the Yellowhead Pass, four classifications were used, in accordance with the Canadian Northern Standards, as to which no special comment is necessary except as to the definition of solid rock, which is the same through the whole work. From Hope to Kamloops, there are only two classifications, which read as follows:—

"All stones or boulders found in excavation measuring more than twenty-seven cubic feet and all solid quarry stone requiring blasting in order to remove it, shall be termed solid rock." "All other materials other than solid rock as described above, shall be termed 'all other materials,' and paid for at the schedule rate for 'all other materials.'" The solid rock definition is a great deal more definite than most, and leaves very little room for the questioning of engineers' decisions.

It may be thought at first sight, that this solid rock definition and the two material classifications would remove many of the classification difficulties, which all engineers have to face. In practice, however, even through country where, as in this case, the material can be broadly classed as rock and gravel or clay; grades of rock are met with, which, although strictly coming under the other material classification, must in equity be allowed for in part as solid rock, and one is again left with the conclusion that no specification can be drawn up, which does not require to be interpreted on the broad grounds of professional intelligence and common sense.

The first concrete pavement constructed in Schenectady, N.Y., which has recently been completed, has some interesting features. It is a one-course pavement, 7 in. thick, of 1:2:4 concrete, made of crusher-run stone graded to 1 in. in size. Expansion joints are placed at an angle of 75 degrees to the curb. William B. Landreth, City Engineer, informs the Engineering News that "while theory could easily prove that there is no advantage in placing the joints at an angle to the curb, we have decided to give the diagonal joint a practical trial. It is not straining anyone's credulity, however, to believe that the weight of a vehicle may be carried across such a small depression on three wheels." The street is 24 ft. wide, and these expansion joints are placed every 20 ft. These expansion joints are ½ in. wide and are filled with several varieties of joint filler, the intention being to observe the action of these various fillers during the fall and winter, in hopes of finding the most suitable one for the given conditions. In constructing the pavement, the gutters have been made deep enough, and the crown of the pavement is of a shape, that when the pavement is worn to an extent to make repairs no longer economical, the city will be able at moderate cost to place on the old concrete a 2-in. asphaltic-concrete surface. This is the first real concrete pavement in the city.

Proportioning Aggregates for Portland Cement Concrete

ONE of the interesting papers read before the American Society for Testing Materials at their convention was that on the above subject by Albert Moyer. This paper has been printed in pamphlet form from the proceedings of the Society and in the introductory pages Mr. Moyer gives the following summary:

"The object of the investigations into the proper proportioning of aggregates for Portland cement concrete is to obtain maximum density which, other things being equal, the author consider gives maximum strength.

"One of the principal results obtained in these investigations was that arbitrary specifications without previous knowledge of the character of the aggregates that are to be used are wrong, and that such stated proportion as 1:2:4 or 1:3:6, etc., are meaningless.

It was found that 95 lbs. per cubic foot, or 3.8 cu. ft. per barrel, as a unit of measurement is incorrect. Investigations prove that it takes 110 lb. of Portland cement to make 1 cu. ft. of paste. The author finds that, opposed to the old plan of filling the voids in sand with cement, these voids must necessarily be filled with paste (cement and water), and that the study of the proportioning of aggregates must be based on the proper proportions of cement, water and sand to make a sufficiently rich mortar to bind together the larger aggregates. The cement must be measured by weight, using 110 lb. as equivalent to 1 cu. ft. of paste. If a 94-lb. bag is used as a unit of measurement, the proportions must be figured so that the same proportion of cement to sand is obtained as when based on 110 lb. of cement per cubic foot of paste.

"For the purpose of economy, various sizes of stone should be used and investigation made to see which sizes will produce the least percentage of voids, so that less mortar may be used and more strength obtained, for the reason that mortar is not as strong under compression as mortar and crushed stone or pebbles mixed together in the form of what we term concrete."

The paper gives various methods of carrying on investigations, so that with a given sand and a given stone or gravel, proportions can be stated by the engineer which will make a concrete of maximum density and maximum strength.

New Pulp and Paper Mill at Bathurst, N.B.

THE illustration on this page is reproduced from a perspective drawing of the new pulp and paper mill which is being erected at Bathurst, N.B., for the Bathurst Lumber Company to utilize the waste from logging and manufacturing. This mill when completed will be the largest plant of its kind in Canada. Two units of this plant will operate next summer to manufacture twenty-five tons daily of bleached Mitscherlich sulphite pulp, and sixty tons daily of extra strong container board. The pulp mill is located at the mouth of the Nepisiguit River. A branch line of the Intercolonial Railway will run directly into the mill. The construction of the plan involves interesting problems with which we hope to deal in detail in a later issue of the Contract Record.

Cost of a Damp-Proof Timber Floor

ENGINEERS are frequently called upon to design and build floors in industrial buildings where water under a head is not encountered, but where protection against dampness must be provided, says J. A. Holmes in an article in The Engineering News. This applies to basement and ground floors where the practice was formerly to carry such floors on heavy timbering, supported by piers, thus providing an air space and more recently by laying the floor directly on a concrete base and spiking to strips embeded in the concrete.

Neither of these methods prevents decay. More recent and extensive practice is to introduce a damp-proof construction under the wood surface directly on the ground. If water is present, a system of underdrainage is necessary.

Where the ground has sufficient natural drainage and no tile is required, the foundation course is laid directly on the ground. On this foundation is spread a layer of tarred sand in which planks are bedded by ramming and on which the hardwood wearing surface is laid and nailed. A floor of this character provides a rigid foundation for machinery and will support the heaviest materials in storage.

A damp-proof floor of this kind was recently built, on which a careful record of cost was kept. The floor was laid in the basement of a manufacturing building on the natural earth, hardpan and sand, without underdrains. The ground was prepared by the contractor for the building by rolling or puddling, therefore, the costs given in the accompanying table are for materials and labor above the ground.

The soft-coal cinders used for the foundation course were purchased from the railroad and delivered in cars on a siding from which they were shovelled directly into the basement where used. Materials were delivered and the work performed in the winter, so that storage in the basement obviated the necessity of heating the cinders when mixed with the tar. Tar was purchased from the local gas works and 14 gals. used per cu. yd. of cinders.

The cinders were spread, rolled and tamped to a thickness of 4 in.; the shrinkage from measurement in cars to place was 36 per cent. Sand and tar were heated outside the building and mixed in the basement. This mixture, while warm, was spread over the cinders and screeded off ⅜-in. above the bottom of the plank; planks being laid to grade for screeding. Into the sand while still warm, the 3-in. planks were firmly bedded by ramming.

For specially prepared tars, 50 to 60 gals. per yd. of sand are specified. On this work the greatest amount of tar that the sand could be made to contain, without making a soft, wet mixture, was 35 gals. per cu.

yd., the same kind of tar being used in both cinders and sand.

The plank was 3-in. kyanized hemlock, planed one side to a uniform thickness of 2¾ ins. and not less than 6 ins. wide, random lengths, square edged and saw butted; laid to break joints and toe nailed but not driven tightly together. There was no loss of plank by cutting.

Over the plank were placed two layers of felt and one of pitch. The felt weighed 14 lbs. per 100 sq. ft. and was laid to break joints one-half the width of the sheet; no pitch was allowed to come in contact with either plank or top floor. The loss in area of felt due to lapping was 21 per cent.

Over the felt and at right angles to the plank was laid a maple-top floor 1 1-16-in. thick.

The waste and shrinkage due partly to laying, but mostly to manufacture, was 40 per cent.; in other words, while the market price of the flooring was $45 per M., the shrinkage in manufacturing that must be paid for, plus a small loss by waste in laying, brought the cost up to $63 per M.

In this work, two distinct classes of labor or trades were employed, roofers in this case and carpenters, and though they worked together, their organizations were separate. For this reason, the combined items for superintendence is high and that for superintendence of roofers unnecessarily so. Reducing the item for superintendence of roofers and using untreated plank and leaving out the felt and pitch between plank and top floor, the cost would be reduced as shown in the last column of the table.

Cost of damp-proof floor

Materials and labor	Thickness of material in place	Quantity per sq. yd.	Unit cost	Cost per sq. yd.	Per cent. of waste and shrinkage	Cost per sq. yd.*
Cinders.......	4 in.	0.151 cu.yd.	$0.50 per cu.yd	$0.076	36	$0.076
Tar in cinders..		0.0381 bbl.	2.00 per bbl. (57 gal.)	0.076		0.076
Sand..........	1 in.	0.045 cu.yd.	1.00 per cu.yd.	0.045	68	0.045
Tar in sand....		0.0276 bbl.	2.00 per bbl. (57 gal.)	0.055		0.055
Felt..........	2 ply	3.10 lb.	35.00 per ton	0.054	21	
Pitch on felt....		3.32 lb.	17.00 per ton	0.028		
Teaming, tar..			0.50 per hr.	0.039		0.039
Labor, roofers..			0.375 per hr.	0.433		0.358
Supt., roofers..			0.50 per hr.	0.100		0.078
Kyanized plank	2 ½ in.	0.027 M.	33.50 per M.	0.905	00	0.756
Maple top floor	1 1/16 in.	0.0184 M.	45.00 per M.	0.603	40	0.603
Nails..........		1.2 lb.	2.10 per cwt.	0.027		0.027
Carpenters....			0.41 per hr.	0.475		0.475
Labor.........			1.75 per day	0.280		0.230
Supt..........			0.50 per hr.	0.080		0.080
Totals....	9 in.			3.226		2.898
			Materials	1.869		1.638
			Labor	1.357		1.260

*Cost omitting felt, pitch on felt, labor placing felt and pitch and using untreated Hemlock plank @ $23.00 per M.

Concrete blocks are to be used for lining the new lake intake tunnel for the Cleveland water supply. The new tunnel is 10 ft. in diameter and 16,000 ft. long from crib 4 to crib 5 in Lake Erie. Crib 4 is located about 1 1-3 miles from shore and crib 5 about 4 miles from shore. About 300 ft. of the tunnel have been constructed with a lining of four rings of brick. The city has recently erected a shield to be used in the construction of this work. The concrete blocks with which it is proposed to line the tunnel will be manufactured and used according to the system patented by Walter C. Parmley, of New York City. According to information received from C. F. Schulz, commissioner of water, a contract has also been made with Charles J. Carpenter and L. W. Anderson, of Grand Rapids, Mich., for the use of two tunnelling machines designed and patented by them.

Portland Cement Concrete as a Paving Material

An interesting discussion of the adaptability of Portland cement concrete for paving purposes forms a part of a paper entitled "Concrete Pavements" which was presented at the recent convention of the American Society of Municipal Improvements by H. G. Lykken, City Engineer of Grand Forks, N.D.

In introducing his subject Mr. Lykken refers to the amount of concrete pavement that is being built and predicts that as regards yardage laid it will soon be "in a class by itself." He ascribes the growing use of concrete, especially in rural work, to the abundance, wide distribution and relative cheapness of the materials employed in its construction and to the relatively lower labor cost of laying it.

All, or nearly all, pavements, according to Mr. Lykken, have their places when regard is had for traffic conditions, climate, first cost and the many other factors entering into an intelligent choice of the best for the case under consideration. But he holds, in addition, that the cement concrete pavement is "so much cheaper in the first cost, so eminently satisfactory under the great variety of conditions it already has been subjected to, that it is well worth investigating just what traffic and other limiting conditions it may be subject to before we pass it by for more expensive surfacings." He states that it would be absurd to claim that a concrete pavement is suitable under every urban condition, but that it is a fact that such a pavement "is suitable for a greater variety of conditions and worthy of greater consideration than that accorded by most engineers at the present time."

It is natural, according to Mr. Lykken, that with so great a yardage, many pavements can be found that are poor or at best indifferent. No one, he argues, would admit that the best student of concrete surfacing among our most eminent road engineers knows all there is to know about concrete pavements, or could lay these pavements with uniform success. We still differ so greatly regarding methods. according to Mr. Lykken, that there are many problems demanding careful consideration.

The first of these problems taken up in the paper is traffic. For rural roadways, Mr. Lykken believes, there is no longer any question as to the adaptability of the concrete pavement, and he states that he is firmly convinced that "it will never have a close competitor except in restricted areas where asphalt is a local product, or where the same can be said of good paving brick." Its low cost and the ease with which it can be kept clean, place it first as an alley and courtyard pavement, for which purposes "it approaches, indeed, an ideal pavement," and has been most widely used in city work to date. He argues that from this would naturally follow its use in somewhat similar conditions—that is, where the traffic moves slowly, but states that it must be admitted that a concrete paving is not suitable where there is more or less fast-moving, horse-drawn traffic. He states that in such cases it is too hard on horses, qualifying the statement by another to the effect that the same can be said of brick or stone pavements. He also states that concrete is not suitable for heavy grades. Continuing, he says:

"But in wholesale and factory districts where the traffic is largely motor-driven or slow, heavy trucking, the hard, even surface of the concrete can not be surpassed. With proper construction and proper materials used, it should wear as well if not better than stone or brick on account of the absence of joints. The one drawback is the greater difficulty of replacement when it does give out and the surface becomes too rough for further use. And here the writer wishes to raise the question, would it not be desirable to lay it in two courses, say 6 to 8 ins. of sub-base, then a wearing surface of 4 to 6 ins., with a parting film of oil or asphalt so that the wearing surface could be stripped off as brick or wooden block surfacing? This would apply only to extra heavy traffic conditions."

On residence streets and on cross-town streets, carrying very little through traffic or very little horse-drawn traffic, according to Mr. Lykken, concrete is eminently suitable, being easily kept clean. While it is often argued that concrete pavements are noisy, according to Mr. Lykken, they are certainly not more so than brick, stone or even creosoted wood blocks.

In summing up, Mr. Lykken states that the concrete pavement with its low first cost and durability demands first consideration for rural roadways, and that with the additional qualities of ease of cleaning and cleanly appearance it ranks high for pavements for alleys, courtyards, cross-town streets, streets in wholesale and factory districts "and, in fact, all streets where the traffic is essentially motor-driven or slow-moving, and in residence districts where there is little or no through traffic." Where there is considerable through traffic or fast-moving, horse-drawn traffic, according to Mr. Lykken, the more resilient pavements of the sheet asphalt or asphaltic concrete type are without question the more desirable, just as in business streets carrying heavy traffic, where the constant grind and pound necessitate continuous patching and repairs, some type of block, either of brick or stone, will prove the more satisfactory.

Details of Construction Which Make Brick Pavements Good or Bad*

THE importance of details as factors of good roads construction is emphasized by the brick highways in Erie and Niagara Counties, New York, which were inspected during the recent annual convention of the National Paving Brick Manufacturers' Association, at Buffalo. Good construction, bad construction and intermediate grades were exemplified. Different kinds of brick, and different makes of the same kind of brick have been used, but while the brick highways range in quality from bad to perfect the differences among them are not wholly attributable to variations in the quality of brick. Both good and bad roads are built of the same kind and make of brick, and sometimes the same contractor built both kinds of roads with one kind of brick.

A noticeable distinction between types of brick was found in the fact that even on roads of inferior construction the sections laid with square-edge brick were uniformly better grouted than were sections of the same roads laid with round-edge brick, although instances of faulty grouting occur with both types of brick.

Damage at Expansion Joints

The contractor has not been at fault in all cases, although his sins of omission and commission are many. The worst roads are those having cross expansion joints. Pavements otherwise in good condition show courses of broken and sunken joints at regular intervals of 50 ft. on account of transverse expansion joints. In some instances courses of brick on each side of the cross expansion joint are broken. But cross expansion joints were specified, and the contractor was obliged to put them in.

The best pavements, and the only perfect pavements, were those having longitudinal expansion joints only, although not all pavements having longitudinal joints were found in good condition. It can, however, be affirmed without fear of successful contradiction, that neither in Erie County nor in Niagara County was there seen a cross expansion joint pavement in perfect condition after two years of service. On some highways, notably road No. 2, running out of Hamburg, cross expansion joints and longitudinal expension joints show at a great disadvantage.

Grouting and Rolling

The visitors received ample proof that a perfect brick highway can be laid and that it will remain unimpaired under traffic conditions for years. The reverse of the picture was exhibited as well. Slipshod methods of construction have been responsible for poor pavements. Faulty foundations and poorly prepared sand cushions are accountable for some defects, but by far the most prolific cause of poor pavements—excepting cross expansion joints—is poor grouting. Poor materials and materials mixed in wrong proportions contribute to poor surfacing, but as a rule either ignorance or carelessness in applying the grout is the source of failure. Too much care cannot be exercised at this stage of construction, but observation teaches that some contractors attach little importance to the details of grouting.

A tour over construction work discovers another cause of poor pavement in the laying of long stretches of brick ahead of rolling and grouting. This method is destructive in case of rain, as brick on a wet sand cushion cannot be rolled without forcing the sand up between the joints. This disrupts the smooth, compacted bed upon which the brick rest and the sand between the bricks prevents the bonding material from penetrating to the bottom of the courses and forming a strong bond. Brick rolled on a wet sand-cushion will rock, nor can a smooth, even pavement be made with a wet sand cushion under it. Contractors are not ignorant of these facts but they take chances and sometimes, unless closely watched by the engineer in charge, they grout over a pavement laid on a wet sand cushion and cover up their folly temporarily. It saves taking up the brick and relaying them. It is easy to uncover such fraudulent work by pulling out a brick here and there, and noting how far the sand has been forced up by the rolling of the brick.

All work should be rolled before leaving it at night. The roller should follow the pavers closely and the grouters should keep as close to the roller as practicable, closing up the work each night. Yet sometimes engineers permit contractors to lay a quarter of a mile or more of brick ahead of the grouters.

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*By F. A. Churchill, of the Dunn Wire-Cut-Lug Brick Company, in the Engineering Record.

Two evils arise from this course—first, the danger of rain on the sand cushion; second, the mixing and the dumping of too much filler at one time in order to rush the work. Unless closely supervised grouters will mix batches too big, and they will put enough grout on the pavement to grout 15 ft. instead of the maximum permissible limit of 5 ft. The inevitable result of putting an excess of grout on a pavement at one time is the same as the result of mixing batches that are too big, namely, separation of sand from cement and consequent weakening of the bonding material. Bridging of joints is another peril from dumping grout on the pavement.

Proportioning Grout

Another observed tendency of grouters is to mix the final coat of grout too thin or too thick. If too thick, the grout bridges the joint; if too thin it settles in the joints instead of setting flush with the pavement. The general tendency is to mix the first grout too thick and the final course too thin. The final grout should be somewhat thicker than previous courses, but it should not be too thick nor should too much of it be put on at one time; it is imperatively necessary not only that the batch be kept thoroughly mixed but it must be thoroughly squeegeed into the joints. In one instance workmen were observed thinning grout by pouring water on it on the pavement, thereby separating the constituent elements of the grout and destroying its efficiency. This fault was corrected, but there is reason for believing that that method of thinning grout is somewhat general. The right way, therefore the only way allowable, is to thin in the grout box and keep constantly stirring.

Contractors and engineers, unless thoroughly experienced in highway work and conscientious in their work, are prone to neglect or slight what appear to be minor details, nor in their methods do they always discriminate between the two kinds of brick commonly used for paving.

Method of Finishing Grouting

The method of finishing the grouting of a brick pavement differs with the type of brick used. The final course of grout on a round-edge brick pavement should be squeegeed until the surface of the pavement is as nearly as practicable free from grout; otherwise, when the excess grout breaks under the pounding of traffic and comes off, it will pull portions of the grout from the round-edge joints. No such danger from a heavy surface coating of grout menaces a pavement laid with square edge brick. The square edges of the brick protect the joint and the excess of grout comes off the pavement without impairing the grout at the joint. The difference between round-edge brick and square-edge brick in respect to the final grouting is this: whereas in tre case of the former all the surplus grout ought to be squeegeed off the pavement, in the case of the latter the surplus may be taken off or left on without deleterious effect. The objection to leaving a thick covering of grout over the pavement is that it is unnecessary and, therefore, wasteful.

The tour of the brick roads of Erie County disclosed the fact that in some instances the failure of contractors properly to protect the freshly grouted pavement with a blanket of moistened sand had resulted in too rapid setting of the filler. The result was "crazing" and pin-cracking of the grout. The same condition was found on the Kennilworth Avenue pavement recently laid by the city of Buffalo.

Laying the Brick

Brick laid with lugs the wrong way brought together two smooth sides of adjoining brick, thereby preventing the penetration of filler and preparing the way for defective spots in the completed pavement. Such faults are the result of inexcusable carelessness, but competent engineers and inspectors detected them in time to forestall serious consequences.

Another indication of neglect to follow specifications was observed in the placing of the uneven or broken edges of bats next to the curb. This is not, perhaps, a serious structural defect, yet it is both aesthetically and practically wrong. It detracts from the symmetrical apearance of the pavement at the sides by giving it a rough, uneven edge, and it deprives the pavement of the extra bonding strength afforded by union of the filler with the rough surface of the bat. Some persons may regard these strictures as hypercritical, but no detail of construction is negligible. A good pavement represents the homogeneous aggregate of all constructive details properly wrought out.

Foundation Drainage

The necessity for proper drainage of foundations was strongly impressed upon observers of brick highways in Erie and Niagara Counties. There are miles upon miles of pavements without cracks, sunken spots, broken bonds or other noticeable defects, yet several highways show cracks and sunken spots unquestionably due, in the first instance, to ineffectual drainage. While it is probably true that longitudinal cracks sometimes result from causes other than defective drainage, a well-constructed foundation, properly drained, is a sure preventive of sunken spots in a pavement, nor are cracks likely to occur unless moisture is taken into the foundation either by direct contact or by capillary attraction.

The tour of inspection around Buffalo found apparent evidence of negligence in the matter of drainage, but conclusive proof was adduced that a well-drained and well-constructed grouted brick pavement is impervious to surface water. Portions of the brick boulevard running from Buffalo to Niagara Falls were submerged by the flood a couple of years ago, for a period of two or three weeks, yet they were absolutely unharmed and were marked neither by cracks, nor depressions, nor by broken bonds. Damage to brick pavements resulting from moisture originates beneath the foundation. That the problem of drainage can be solved even under adverse natural conditions is a fact which was demonstrated on the tour.

Cull Brick

For almost its entire length of 23 miles the boulevard between Buffalo and Niagara Falls runs through a level country, and the same is true of the highway between Lewiston and Youngstown. Yet in the former only a few bad spots exist, and in the latter none at all. The worst spots on the boulevard are attributed to the use of cull brick. This brick, it is alleged, was condemned in Niagara County, but by some means the culls found their way across the line into Erie County and were placed in the pavement at two points. It might be an idle waste of time to speculate on the sequence of events which eventuated in the translation of brick from a cull pile in one county to a snug place in a State boulevard in the county adjoining, but it is only fair to say that the manufacturer who furnished the brick says he received cull prices for the cull brick and was not cognizant of the high destiny which awaited them. Without attaching to the incident any remote significance, the incident does emphasize the need for close supervision of construction work by engineers in charge, and it puts an acute accent on the necessity for honest, capable and diligent inspection. Eternal vigilance is the price of a good pavement.

Inspection

Poor judgment of the qualities of brick is a weakness not infrequently found in inspectors. Among culls thrown into the discard by inspectors on construction work were found what practical men declared to be the very best brick in the shipment. Conversely, some of the brick that were passed were of inferior quality. Without making any specific application to individuals or to any particular job, it is safe to affirm that inspection of brick on the roadway is to some extent a matter of individual preference, and in many cases inspectors are not qualified by experience or by native ability to judge correctly of the quality of brick by its appearance. The result is an almost total absence of uniformity in standards of judgment and an insistent demand for a better system, or at least for expert inspection.

There does seem to be among inspectors a common prejudice against brick of a dark shade, although it is quite possible that such brick may be exceptionally durable. The shade is not always an indication of overburning. The inspection of brick is often delegated to persons selected without regard to their fitness for the duty; and brickmakers may be mulcted from 2 to 3 cents per brick on large consignments by the ignorance of inspectors appointed for political reasons or for other reasons equally obnoxious. Nor is the abrasion test always fair to the brickmakers.

These reflections and comments are based upon observations made on old and new work in a recent tour of two hundred miles over highways in Erie County and Niagara County, New York.

Simple Rules for the Weight of Iron and Steel Bars

The following simple rules for figuring the weight of iron and steel bars are given by Ferro-Concrete.

Round Steel Bar—Square the number of quarters of an inch in the diameter, and divide by 6, the result being the weight in lbs. per ft. run.

Example for 1½-in. diam. bar: $6^2 \div 6 = 36 \div 6 =$ 6 lbs. per ft. run.

Square and Flat Iron Bars—Multiply the number of sq. in. in the cross-section by 10 and divide by 3, the result being the weight in lbs. per ft. run.

Example for a 2-in. by ½-in. bar: $1 \times 10 \div 3 =$ 3.33 lbs. per ft. run.

Example for 1½-in. × 1½-in. bar: $2\frac{1}{4} \times 10 \div 3 = 7\frac{1}{2}$ lbs. per ft. run.

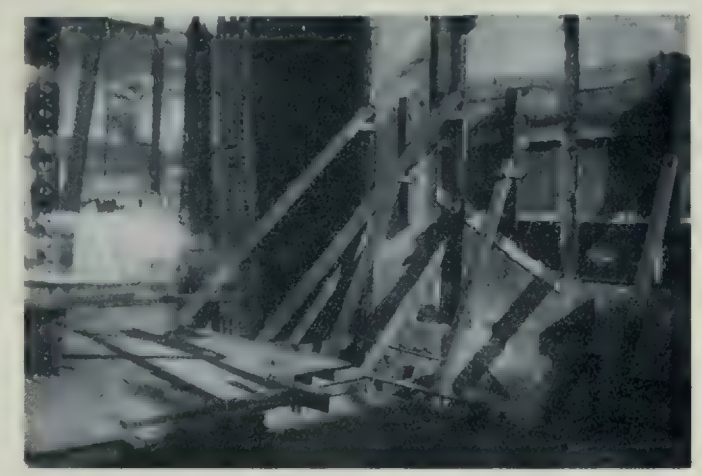
Square and Flat Steel Bars—Proceed as for iron and add 2 per cent. to the result.

Cleaning Pressed Brick Stained by Smoke

FOR the cleaning of bricks in the walls of a church that had been blackened by coal smoke and which settled on the coping and washed down over the light-colored hydraulic pressed brick, and where dilute muriatic acid, pearline and other substances had been tried without satisfactory results, the Painters Magazine suggests the following: Muriatic acid will not remove smoke stains, nor will soda or soda ash do it. Smoke stains must be removed by scrubbing and rubbing with the proper solutions. Try the following method: Mix one gallon soft soap, two pounds powdered pumice and one pint of liquid ammonia, beating the mixture well. After carefully dusting the brickwork, apply the mixture. This should be in the form of a soft paste, in a fairly thick layer with a fibre brush, allowing it to remain for about twenty minutes; then rub it in on the bricks with a good, stiff scrubbing brush, using plenty of elbow-grease. Use a large sponge and plenty of lukewarm water to remove the lather, and then rinse with clear water, or, if convenient, use a hose for rinsing. This, if properly done, will remove the most stubborn case of discoloration by smoke from brick or stone.

An Interesting Piling Contract at Montreal

As already stated in the Contract Record, difficulties were met with in excavating for the foundation of the new Bank of Toronto to be erected at the corner of McGill and St. James Streets, Montreal. Tests made by the consulting engineers indicated that one-half of the site, next to St. James Street, was able to carry the heavy load which would be imposed upon it, while the other half was of such a nature that it was necessary to use some system of deep foundation in order to develop the ground to a bearing value equal to the good half.



Illustrating method of bracing walls.

After considering several methods, the engineers decided to employ concrete piles, and the contract was awarded to the Simplex Construction Company, of Montreal, who had previously carried out piling contracts at the extensions of Nos. 1 and 2 elevators of the Montreal Harbour Commissioners, Dominion Coal plant, and Grand Trunk elevator, Windmill Point.

The contract for the Toronto Bank building involved the placing of 150 Standard Simplex piles. The pile driver is mounted on two heavy iron rollers under which large timbers are placed. The cast iron point weighing about 150 pounds receives the end of a 16-in. steel form in such a way that it effectively seals it. A cast steel driving head is used, this fitting the leads of the driver so that it keeps the form in place and holds a wooden block on which the hammer falls. After the 16-in. form is driven down to a penetration of ½ in. under the blow of a 3,000 pound hammer falling 15 feet, the driving head is removed, reinforcement placed inside the form and concrete poured in until the form is filled. The form is then withdrawn, leaving the point at the bottom; the result is a reinforced concrete column of uniform diameter throughout. The machine is afterwards moved to the location of the next pile. Piles have been driven to a maximum depth of forty-seven feet below the excavation, which means that the foundation extends about sixty feet below the street level. A foundation extending so far below the street level should be positive protection against any disturbance which might otherwise be incurred by the installation of subways, etc. The piles driven on the job referred to will each bear a minimum load of thirty tons.

In placing the piles for this foundation it was necessary to drive close to the walls of the adjoining buildings, which were, owing to age and several fires through which they had passed, in bad condition. As a matter of precaution heavy bracing was necessary, but the piles were driven without any serious disturbance. The entire site will be covered with a reinforced concrete matt, so as to ensure a uniform foundation.

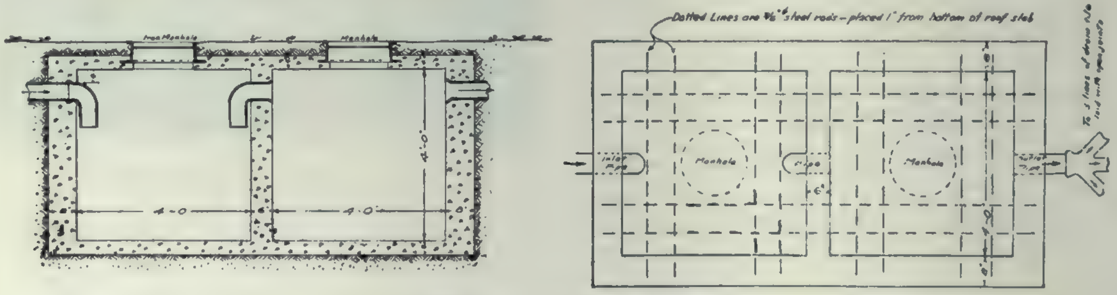
The Simplex Company placed the piles in about a month, which, under the conditions, is considered very rapid work.

Construction of Concrete Septic Tanks

A Sewage Disposal System for Country and Suburban Houses—Size and Location of Tank—Materials Necessary

THE well-managed farm of today means many household conveniences as well as labor-saving farm machinery. Back-breaking drudgery has been largely eliminated from both house and fields. Running water and the kitchen sink and bathroom have supplanted the old-time pump and open, insanitary drainage. But the most efficient disposal of sewage remained a problem until the concrete septic tank was invented. It is a simple, cheap and effective device, rapidly supplanting the drywell, with its constant menace of water pollution. In brief, there has come to the farmer his own little sewerage plant in concrete, which answers his purpose even better than large city works, for he has neither the tax nor repairs that attach to a city sewer system.

The principle upon which the concrete septic tank operates is extremely interesting. It consists of a long, water-tight cistern, through which sewage passes very slowly and evenly. Located underground, it is warm and dark, thus affording perfect conditions for the development of the bacteria or germs which clarify and render harmless the sewage. After passing through the septic tank, the sewage is practically free from all suspended matter and has the appearance of water. From the septic tank this clear effluent is discharged into three lines of ordinary farm drain tile.


Iron Manhole
Manhole
4-0
4-0
4-0
Dotted Lines are 3/8" steel rods – placed 1" from bottom of roof slab
Inlet Pipe
Manhole
Pipe
6"
Manhole
Outlet Pipe
To 3 lines of drain tile laid with open joints

Construction of concrete septic tanks.

Size and Location of Tank

While the odor from a septic tank is scarcely noticeable, it is nevertheless best to locate it at some distance from the house. Choose a spot easy to excavate so that the top of the tank can be sunk 6 inches below ground level and where the lines of drain tile will have sufficient fall to carry off the discharged fluid. The tank should be large enough to hold the ten people occupying a house having two bathrooms fitted with the customary washstands and downstairs the kitchen sink, a concrete tank having two compartments, each 4 feet long by 4 feet wide by 4 feet high, will be required. Since the top and bottom are each 4 inches thick and the top of the tank is 6 inches below ground level, dig the pit 5 feet 2 inches in depth. The walls of the tank are 8 inches thick and the partition between the two compartments 6 inches. Therefore, the length of the pit should be 9 feet 10 inches and the width 5 feet 4 inches.

Making Forms and Placing Concrete

If the earthen walls of the pit stand firm only inside forms will be needed. These inside forms are merely boxes made of 1-inch boards. The boxes will be required to make two compartments. The out-entire sewage for one day. For a family of eight to side dimensions of the boxes should be 4 feet square by 4 feet high. The boxes or forms will be placed on the freshly laid concrete floor. Holes for taking 6-inch pipe should be made in the boxes as shown in Fig. 1. The holes should be 4 inches from the top of the box form, measuring from the top of the hole. The concrete should be mixed in the proportion of 1 part Portland cement, 2 parts sand and 4 parts crushed rock or gravel. Place a 4-inch thickness of concrete in the bottom of the pit to form the floor of the tank. On top of this concrete set the box forms, which should be ready for immediate use. Place the forms so that there is a space of 6 inches between them and an 8-inch space between them and the earthen walls of the pit. Then commence depositing the concrete for the walls and partition. As soon as the level of the concrete reaches the holes in the

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*By Percy H. Wilson in the Building Age.

forms place in the holes 6-inch pipes as illustrated. Then continue the concreting until even with the top of the forms.

Reinforced Top and Manholes

Two ordinary iron manhole frames and covers may be obtained from a local dealer in building supplies. The manhole covers should fit tightly and should not be perforated. The manhole frames should be 10 inches high so that when placed on top of the forms the upper edge will be even with ground level. If the manhole frame is of less height than this, it should rest on a circular piece of 1-inch board, which is nailed to the top of the form. Since the concrete roof is to be self-supporting, it will be necessary to reinforce it with a few lengths of ⅜-inch round steel rods. There will be needed 4 pieces of ⅜-inch rods, 9 feet 6 inches long, and 8 pieces 5 feet long. The roof is now ready to be placed. Place the manhole frames in proper position on top of the form, and deposit the concrete to a depth of 1 inch and on the concrete lay the long and short bars, as shown in Fig. 2. When the bars are placed, deposit the balance of the concrete so as to bring the roof to a total thickness of 4 inches. As it will be covered with earth it is not necessary to give this top surface a smooth finish, merely level the surface by striking off with a straight piece of board. The tank should now be allowed to rest undisturbed for at least two weeks. At the expiration of this time, saw away wooden top of the forms inside of the manhole frames. Then enter the tank and remove the wooden forms, passing the lumber out of the manhole opening. While in the tank make certain that the pipes are all unobstructed and not even partially clogged with dirt or lumber. The inlet pipe is then connected to the pipe from the house and the outlet pipe joined to three lines of 3-inch concrete drain tile. The drain tile will be laid about 12 inches below the surface of the ground and the joints left open, that is to say, no mortar must be used in the joints. This permits the discharged fluids to be absorbed by the surrounding soil. The drain tile lines should be laid in the form of the letter "Y" and sufficiently extended to cover a large area of ground. Average conditions require that each arm be about 100 feet long. After this is done, cover the tank with earth to the level of the manhole covers. It is now ready for use.

Materials Necessary

A tank of the size specified will require about four cubic yards of crushed rock, two cubic yards of sand and seven barrels of Portland cement. There will also be needed 78 feet of ⅜-inch round steel rods, which can be obtained from the local blacksmith or hardware dealer. The tank can be built without skilled labor. It requires few tools and construction methods are so simple that one man can build it.

Causes of Failures in Concrete Structures

FAILURES in concrete or reinforced concrete structures may be divided into two classes, says Concrete-Cement Age:—(1) failures from unavoidable causes, and (2) failures from preventable causes.

Failures from unavoidable causes include those resulting from earthquakes, explosions, lightning, fire, inundations, tempests and exceptional shocks. As these causes are, by their nature, unavoidable, nothing further need be said about them beyond the remark that concrete structures, if designed for the purpose, will withstand most of these forces as well as or better than any other building material.

Failures in plain concrete structures from preventable causes are almost invariably due to mistakes or carelessness in construction, some of the common causes of failure being as follows:

(1) Use of green and unseasoned cement as well as poor cement. A branded American cement is usually reliable, but it must not be too quick setting or lumpy or caked.

(2) Unsuitable aggregates, i.e., inferior grades of sand and stone. It is particularly necessary to avoid using any aggregate that may be handy. The best for the purpose should be chosen. It is also unwise to accept aggregates on the basis of small samples.

(3) An insufficiently graded aggregate, particularly one containing only very coarse material, or one with too much sand or loam. Natural aggregates are risky on account of the variations in the proportion of sand they contain, and should be screened before use.

(4) Dirty aggregate or water containing earthy matter, clay loam, or strongly colored water.

(5) Carelessness in proportioning mixtures.

(6) Badly mixed concrete, i.e., incomplete incorporation of the aggregate with the cement.

(7) Too much water during mixing, or water carelessly applied, or an insufficient quantity of water to permit the concrete to attain its full strength.

(8) Allowing the concrete to stand until the setting action has commenced and then re-gauging before use, or using up old concrete.

(9) Setting concrete work on dry foundations and without thoroughly saturating the surface with water.

(10) Excessive ramming or tamping.

(11) Placing concrete in the winter months and allowing the material to become frozen before the cement has attained its final set.

(12) Excessive use of calcium chloride for lowering the freezing point.

(13) Placing concrete in very hot weather when the temperature of the water is around 90 deg. F. to 100 deg. F., the cement at the same time being improperly seasoned, with the result that the cement gets an initial set in the mixer and is thereby broken when placed in the work.

(14) Excessive trowelling or floating of cement surfaces.

This analysis will show that a great number of the failures are due to mechanical incompetency.

From the past history of concrete there is good reason to believe that if Portland cement is properly manufactured, the proper kind of aggregates used and the work properly done, structures built of concrete will be reasonably permanent.

Concrete is one of the best and most reliable of building materials when mixed and put in place in a proper manner; where there have been failures in reinforced concrete buildings or other reinforced structures for that matter, it has generally been due to one or more of the following causes:

1. Premature removal of forms. Too early removal of forms has been the cause of most of the deplorable accidents in reinforced concrete construction.
2. Insufficient or badly arranged forms and supports.
3. Erroneous design, i.e., errors in calculation or insufficient and poor reinforcement.
4. Mistakes in the construction of the columns.
5. Unsuitable aggregate or cement.
6. Poor mixing.
7. Bad workmanship or in efficient supervision.

8. Misplacing or omitting the reinforcement.

Any of the above causes or any of those stated for plain concrete failures may be responsible for a reinforced concrete structure being a failure, but there is absolutely no reason, if these matters are carefully attended to, why every structure should not be a complete success.

It is a noteworthy fact that practically no "mysterious" failures have ever occurred in concrete structures long after they have been completed, so that it may be assumed that in almost every case the failure has been due to some error in construction.

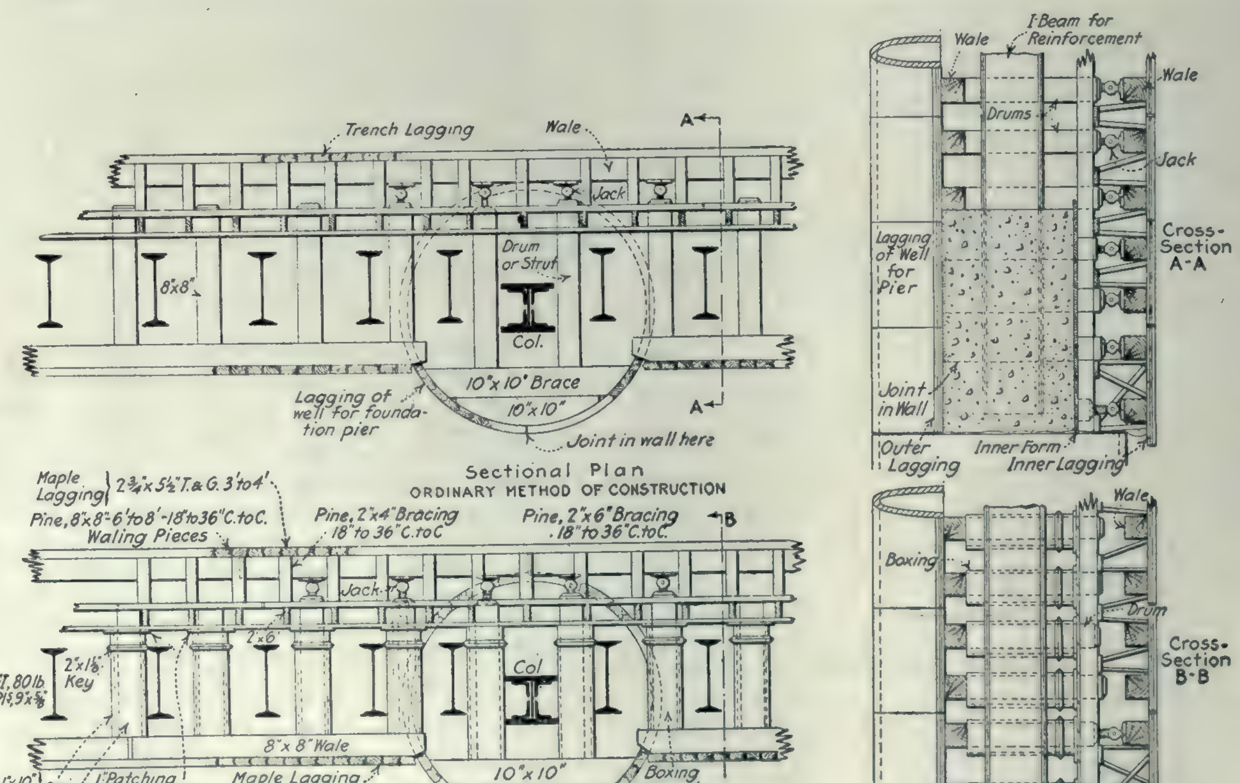
The carelessness and ignorance of some contractors who undertake concrete work, and the indifference they show with regard to inspection during construction, make it essential that all concrete work should be placed in the hands of skilled and trustworthy men. While the contractor should not be absolved from blame, yet the engineer and the architect, who do not know the dangers, must equally share the responsibility. It is their business to know the necessary precautions and to insist that a competent concrete engineer or experienced inspector be put on the job, to stay there until the work is completed. It is high time that those be adjudged incompetent who fail to insist upon such supervision.

It is confirmed, concludes our contemporary, that all localities in which a good code of regulations is enforced have proved free from great disasters of a preventable nature.

Construction of Retaining Walls of Deep Basements in Clay Ground

In many of the large new office buildings in Chicago, having foundation piers sunk through the clay bed to rock, a portion of the area is excavated for two or three (or even four) basement floors. These excavations must be surrounded by heavy retaining walls to resist the pressure of the clay. The walls are built in trenches excavated to the required depth, lined with sheeting against which are placed waling timbers, braced by cross timbers or "drums" having a jack screw or trench brace between one end of the drum and the waling timber.

Under the ordinary method of building the wall, the forms are placed in position in the trench thus braced, and then concrete is deposited up to the level of the bottom of the first row of drums. This layer of concrete is allowed to set or harden for 12 to 24 hours. New drums are then placed behind the concrete-filled portion of the form. Then the drums and



Methods of Constructing Retaining Walls for Deep Basements in Clay Soil at Chicago

The upper drawing shows the method ordinarily used. The lower drawing shows the improved method employed by Holabird & Roche on the new Lumber Exchange Building.

jacks of the row above the concrete are removed, after which the forms are set for the next course and another layer of concrete is deposited to fill to the level of the next row of drums. This is indicated by the horizontal dotted lines in the upper drawing of the accompanying cut, and the operations are continued successively until the top of the wall is reached. The outer lagging is left in place, but the outer waling timbers are removed at the same time as the drums.

This method has several disadvantages, one of them being the slow rate of progress on work where rapid construction is usually most desirable. Then, the walls are not monolithic, but are composed of a series of separate horizontal courses, and although these are united by keys or ribs, the arrangement is not well adapted to resist heavy lateral pressure. Certain floor panels in the floors above must be left open to allow of placing a reinforcement of vertical steel beams, as it is not satisfactory to use steel-rod reinforcement, owing to the large number of horizontal joints and the difficulty of taking care of shear. The pressure of the earth also has to be resisted by the green concrete, which in many cases is displaced or distorted to some extent. This allows a movement of the clay body which may affect adjacent buildings.

In the construction of the Lumber Exchange Building, at La Salle and Madison Streets, a new method was adopted for building the sub-basement retaining walls, the lower sub-basement floor being about 50 ft. below the street. The trenches were excavated in alternate sections, the joints being at the centres of the columns. They were 6 ft. wide, and sunk in 3-ft. lifts, each lift sheeted with 3 x 6-inch vertical lagging and two lines of 8 x 8-in. horizontal waling. The 8 x 8-in. drums were then placed between the waling timbers and made as tight as possible by the screws. This process was continued lengthwise in 6-ft. sections along the trench and then downward to the desired elevation.

After the excavation of the trench was completed about 6 in. of concrete was deposited for a working floor and forms were built for the full height of the wall. The forms were cut away around the drums, which were boxed in or cased with 1-in. lumber; ribs on the boxing formed grooves or keys for bonding with the concrete filling later.

Then the trench was concreted from base to top in one operation, thus giving a homogeneous or monolithic wall, which was allowed to set for about two weeks, the pressure of the earth during that time being resisted by the drums or struts and not by the forms and concrete as in the other method described. The outer waling and lagging are left in place. When the basement is excavated the inner lagging is removed, the drums are pulled out of their boxing, and the inner form and boxes taken down. The holes left by the boxes are then filled with a dry concrete, well rammed, which is held in place by the notches or grooves formed by the keys. This method is shown in the lower drawing.

The advantages of this method are that the work progresses much more rapidly and gives a monolithic construction, while it eliminates the objection to rod reinforcement in these walls (though in this case some of the walls contain I-beam reinforcement). Another important advantage is that the drums take up the pressure, and relieve the wall of all pressure until the concrete has become thoroughly set and hard.

The building in question is a 16-storey office building about 135 x 101 ft., 200 ft. high above the street and with its sub-basement (for boiler room) 50 ft. below the street. The prevention of any movement of the clay bed was very important, since the 16-storey Y. M. C. A. building with floating or grillage foundations adjoins the south side of the site, while the 13-storey Tacoma Building, also with float foundations, is across the street, and an old 3-storey building with surface foundation is adjacent.

The architects are Holabird & Roche, of Chicago, and the new method of basement wall construction was devised by them. The George A. Fuller Company, is the general contractor.—Engineering News.

Miscellanea

The American Society for Testing Material has added to its specifications for reinforcing steel rolled from billets, an intermediate grade between the structural and hard grades. The new grade has a yield-point of 40,000 lbs. and an ultimate tensile strength of from 70,000 to 85,000 lbs.

A model town has been built within the city limits of Duluth, by the Minnesota Steel Company, in connection with its new steel works in that city. The town includes water supply and sewerage systems, concrete paved streets, about one hundred and forty residences, a hospital and a school.

A series of tests to determine the strength of glue were made by Messrs. O. Linder and E. C. Frost, and reported to the recent meeting of the American Society for Testing Materials. The results show a strength of from 1100 to 1950 lb. per sq. in. for a glue made of 1 part dry glue and 3 parts water, and a strength of 60 to 70 per cent. of the above figures for a 1:5 glue. Prolonged heating lowers the strength of the glue. Glue solutions heated to 150 deg. F. for 20 hours showed a loss of 30 to 45 per cent. in strength.

Students of the leading engineering schools have been offered an opportunity to compete for $1,000 in prizes for essays on highway construction. The subjects suggested cover a wide range, including—factors which should govern the choice of types of pavements and roads and the materials used therein; an ideal paving program for a city of 25,000; economics of highway construction, and half a dozen related topics. The prizes are offered by The Barber Asphalt Paving Company to promote investigation of highway problems by engineering students and to encourage them to enter a field of work where there is great need for trained men.

Of the new uses for concrete the latest is in the building of a ferry landing at Sydney, Australia, where a big pontoon made of reinforced concrete was adopted. It is 100 ft. long, 68 ft. wide at one end and 43 ft. at the other, and 7 ft. 9 ins. deep, giving it a freeboard of 32 ins. The bottom is flat, and the ends are given an inclination of 70 deg. The pontoon is divided into 48 watertight compartments, and is carefully reinforced so as to withstand the pressure of vessels lying alongside. A live load of 150 tons is provided for, and the structure weighs 650 tons. It is expected that this concrete structure will require little attention to the way of repairs, will be permanently watertight and will overcome many other troubles to which the ordinary wooden or steel pontoons are subject.

Asbestos and Portland cement for many years have proved good partners in fireproof construction and property protection. A new building material is just being turned out in Switzerland where large slabs or boards are made under pressure, with Portland cement and asbestos fibre, forming the principal ingredients. The slabs, 1-in. thick and about 4 ft. by 15 ft. in area, may be cut as desired at the factory and are adapted for outside walls, inside finish, certain furniture and many other uses. Cement and asbestos have for many years been used with admirable results in making shingles and for other similar purposes and the short-fibre asbestos which is to a cetrain extent a by-product of the production of the high grade, long fibre asbestos, capable of being spun, finds its way when mixed with Portland cement into many uses in the line of building construction.

The problem of economical distribution of concrete for long and comparatively low structures, such as arches and viaducts, is frequently solved by the use of long gravity chutes running from high hoisting towers to the points of deposition.

The Department of Trade and Commerce, Ottawa, is advised that a company has been formed in Sydney, New South Wales, for the purpose of manufacturing asbestos in Australia, and that they are erecting works for that purpose. As they will require crude asbestos they have inquired as to the source of supply, freight rates and other particulars concerning Canadian asbestos. They are contemplating sending a member of their firm to Canada to study the situation. It has been suggested that they might wish to begin by importing manufactured asbestos goods, and that with this in view they might desire to get into touch with Canadian producers of these goods. It is hoped, therefore, that Canadian asbestos manufacturers will follow up this notice by communicating with the firm in question—the name and address of which may be had on application to the Department of Trade and Commerce, Ottawa—and that this may result in the establishment of a permanent trade connection.

Mr. E. L. Warner, lately appointed Eastern representative of the Dominion Paint Works, Limited, Walkerville, Ont., has removed from Transportation Building, to larger quarters in the Eastern Townships Bank Building, Montreal. His head office is in the Lumsden Building, Toronto.

A bulletin received from Mr. C. R. Young, Chairman of the Library Committee of the Toronto Branch of the Canadian Society of Civil Engineers, directs attention to recent additions to the library in the way of Transactions, Proceedings, Journals, Reports, Engineering Treatises and Text-Books. A printed catalogue of the whole library is to be prepared and distributed in the near future. Members of the Branch are invited to consult the complete card catalogue which may be seen at Headquarters, 90-96 King Street West.

The Canadian Billings & Spencer and the Canada Forging plants are now working to limit. These two plants were consolidated as the Canada Foundries & Forgings, Limited, a few years ago. Industry showed a falling off during the first half of the present year, but during the last couple of months there has been a sudden accession of orders which has taxed the capacity of the plants. It is stated that the orders on hand at present represent more, both in bulk and in money, than the entire output of 1913. Many of the orders are on account of the Dominion and Imperial Governments, portions of the Ross rifle being manufactured here. One of the plants also has been working on heavy shells for the Imperial Government.

Personal Mention

Mr. J. J. McNiven has been appointed assistant inspector of gas and electricity for the City of Vancouver.

Mr. R. A. Ross, consulting engineer, Montreal, is acting for the City of Peterborough, Ont., in its negotiations for the acquisition of the plant of the Peterborough Light & Power Company.

Mr. Herbert S. Hersey, General Manager of the C. O. Bartlett & Snow Company of Canada, Limited, Montreal, is reported as improving daily following an optical operation on October 20th.

Mr. C. A. Lee is scheduled to read a paper, "Jordan River Power Development, Vancouver Island," before the Vancouver Branch of the Canadian Society of Civil Engineers on November 19.

Mr. R. S. Gillette, previously connected with the Sanitary Tiling Company, has opened offices at 809 Eastern Townships Bank Building, Montreal, as the Canada Tile Company, tile contractors and associated lines.

Mr. Thos. Adams, town planning expert to the Commission of Conservation, delivered an address at Berlin, Ont., last week. The municipal councils of Berlin and Waterloo attended. The meeting was held under the auspices of the Berlin Civic Association.

Mr. Gordon B. Johnson, Canadian Trade Commissioner at Yokohama, Japan, an engineering graduate of the Royal Military College, Kingston, has volunteered for active service and has been accepted by the Imperial Government. He is now on his way to England.

Mr. C. S. L. Hertzberg, of the Trussed Concrete Steel Company, writes us from Walkerville stating that he has not volunteered for active service abroad. In our issue of November 4 we published a list of members of the Canadian Society of Civil Engineers who had gone on active service with the Canadian Expeditionary Force. This list contained the names of Mr. C. S. L. Hertzberg and Mr. H. F. H. Hertzberg. The latter only should have been included.

Dr. J. A. L. Waddell and Mr. John Lyle Harrington announce the dissolution of the firm of Waddell & Harrington, Kansas City. The firm's business will be conducted as usual until the conclusion of its affairs in July, 1915, except that it is accepting no new commissions. Dr. Waddell will give his attention to special engineering and financial matters and to important advisory work. Mr. Harrington will be joined by the firm's Associate Engineers, Mr. E. E. Howard and Mr. Louis R. Ash, in the establishment of the firm of Harrington, Howard and Ash.

The following gentlemen have been nominated for officers and members of Council of the Canadian Society of Civil Engineers for 1915, as submitted by the nominating committee: For president, F. C. Gamble; for vice-president for three years, A. E. Doucet and A. St. Laurent; for vice-president for one year, E. E. Brydone-Jack and Gordon Grant. For Councillors—Ditsrict No. 1, S. P. Brown, H. R. Safford, A. Surveyer, R. M. Wilson; District No. 2, C. B. Brown, F. W. W. Doane; District No. 3, A. Amos, T. A. J. Forrester; District No. 4, G. J. Desbarats, A. J. Grant; District No. 5, S. B. Clement, J. L. Weller; District No. 6, W. G. Chace, F. H. Peters; District No. 7, N. J. Kerr, D. O. Lewis. With the exception of the nomination for President, two members are proposed for each office. The officers to be elected are a president, a vice-president for the full term of three years, a vice-president for a term of one year, two members of council representing District No. 1 and one member of council for each of the other districts.

Mainly Constructional

East and West—From Coast to Coast

EASTERN CANADA

At Ottawa, paving work estimated to cost $114,000 has been commenced on Preston Street between Carling and Wellington Streets.

Announcement is made that the Steel Company of Hamilton will re-open one of their furnaces on November 20, employing one hundred men.

The Jeffrey Manufacturing Company, Montreal, have removed their office to 425 Power Building. The warehouse will remain at 55 Cote Street.

The Interprovincial Brick Company, Limited, Toronto, have secured the entire face brick contract for the Proctor & Gamble plant at Hamilton.

The Associated Cement Company (Canada), Limited, has been incorporated at Ottawa. It is reported that Messrs. Mackenzie & Mann are behind the new firm.

Tenders for street railway equipment to cost $130,000 have been awarded to the Canadian General Electric Company, Toronto, by the London & Port Stanley Railway Company.

The Ottawa City Council has passed a by-law for the expenditure of $250,000 on the construction of an intake. The work is to be started at once. Mr. R. L. Haycock is the Engineer.

The Toronto City Council have approved the construction of a new street railway line on Bloor Street from Dundas to Quebec Avenue. The estimated cost of the work is $125,000.

The Barton Sand & Gravel Company, Hamilton, Ont., has been incorporated with a capital of $100,000. Those interested in the new enterprise include Dr. E. A. Alway, of Bartonville, Ont.

Work has started on the Port Credit and Burlington sections of the new concrete highway between Toronto and Hamilton. The estimated cost of the undertaking is $600,000. Mr. H. S. Van Scoyoc is the Engineer.

At Hochelaga (Montreal), the new school building which is being erected for the School Commissioners is advancing rapidly in its construction. The architects are Messrs. Viau & Venne, and the general contractor is Mr. J. A. Durocher.

The Mimico, Ont., Council have decided to submit a by-law authorizing the construction of water and sewerage schemes for the village. Plans for the work have been prepared by Mr. E. A. James. The work is estimated to cost $125,000.

From Owen Sound, Ont., comes the report that Mr. R. H. McWilliams, of Owen Sound, and Mr. John Russell, of Toronto, have purchased about forty acres of the gravel area at Griffiths Island, where they will engage in the manufacture of cement.

Negotiations have been completed for the construction of a pipe-line to supply St. Catharines, Welland, Merritton and Thorold direct from Lake Erie. Tenders for the work are to be called shortly. The estimated cost of the undertaking is $1,000,000.

The contract has been signed for the Park Avenue subway at Montreal and work is to start immediately. The engineer in charge is Mr. J. Emile Vanier and the general contractors are Messrs. Laurin & Leitch. The estimated cost of the undertaking is $176,000.

Work has started on the new physics building at the Ontario Agricultural College, Guelph. The structure will be 100 feet x 65 feet in size, three storeys high, and will cost about $50,000. The building fund is a portion of the Federal grant to Ontario for agricultural purposes.

Work has been completed on the new Government dock at Belleville, Ont., by the Randolph Macdonald Company of Toronto. The contract called for concrete work. The wharf is extensive, projecting far out into the Bay of Quinte. Dredging work has not yet been completed.

The gratifying announcement is made that the Massey-Harris Company will re-open its works in Toronto and Brantford on the first of December. The company expect a great demand for their implements next spring as a result of the stimulus to farming in Western Canada created by the war.

Plastering is in progress on an apartment block at Port Arthur, Ont., estimated to cost $100,000, for Port Arthur Buildings, Limited. The building is to be of terra cotta, reinforced concrete and brick construction. The architects and general contractors are Messrs. Marsh, Hutton & Powers Company, Limited.

Exterior work is advancing rapidly on the new office building which the Liverpool, London & Globe Insurance Company are building on Dorchester Street West, Montreal, at a cost of $175,000. The architects are Messrs. Nobbs & Hyde and the general contractors are Messrs. E. G. M. Cape & Company, both of Montreal.

It is proposed that the city of Montreal form a department for the inspection of all electrical work. This work has hitherto been done by the Canadian Fire Underwriters' Association, which has now incorporated a separate company —the Canadian Underwriters' Electrical Inspection Bureau, Limited,—to take over this part of the business. The city law department will report on the city's powers to establish a department.

Notwithstanding war conditions, things appear favorably with the Cheticamp Gypsum and Plaster Company, Limited, according to the reports of Mr. James Brodie, who is on a trip to the company's properties at Eastern Harbor, C.B. Although the quarry output has been taken by American Plaster Mills for the next five years, new rolling stock and equipment, such as steam shovels, locomotives, dump cars, etc., is being added. The company markets all its manufactured plaster in Canada. The machinery is on the ground and will be installed this winter. As a result the output will be increased very largely.

Another effort is to be made to remodel the Montreal building by-laws, which have been under consideration for several years. A committee consisting of Messrs. Francis and Venne spent many months in revising the code, but this has failed to meet with approval, as portions of the code conflicted with other municipal regulations. It has therefore been decided to submit the entire matter to a special committee of the Civic Legislature Committee—Messrs. A. Chausse, building inspector; the City Clerk, Ald. Lapointe, and the city attorney, Messrs. Francis and Venne being invited to consult with the special committee.

WESTERN CANADA

The Calgary City Council is making arrangements to appoint a special committee to deal with the question of city planning.

At West Burnaby, B.C., an eight-room school building is to be erected at a cost of $50,000. Plans are being prepared by Mr. J. H. Bowman.

The third annual convention of the British Columbia members of the Canadian Society of Civil Engineers is to be held at Victoria, B.C., December 11-12.

Application for authority to carry out the construction of the proposed Peace River Railway will be made at the next session of Parliament by the Peace River and Athabasca Railway Company.

The new building which has been erected on Qu'Appelle Avenue, Winnipeg, for the Knox Presbyterian Church, at a cost of cost of $225,000, has reached the roofing stage. The architect is Mr. J. H. G. Russell, and the general contractors are Messrs. Jas. McDiarmid & Company, both of Winnipeg.

Fort George, B.C., reports activity in building work. During the last three months residential and business buildings to the value of $500,000 have been erected. The value of the work at present under way is $250,000. The largest work now under construction is that for the Grand Trunk Pacific Railway.

The extensions to the White Valley irrigation system will be completed in about five weeks. The work is under the supervision of Messrs. Ducane, Dutcher & Company, Vancouver. Next spring further extensions and revisions will be started, at an estimated cost of about $100,000. The entire system has cost $550,000.

The new bank building which the Merchants Bank of Canada are erecting at Calgary at a cost of $122,000 is nearing completion. The building is three storeys high, of steel and brick construction, with a stone and granite front. The architects are Messrs. Brown & Vallance, of Montreal, and the general contractors are Messrs. Carter-Halls-Aldinger Company, of Winnipeg.

At Calgary, operations are about to be commenced on the new warehouse and office building for the Western Canada Cordage Company. Four buildings will be erected at present—the main building, fibre warehouse, machine shop and office building. The architect is Mr. Chas. Hay, and the general contractors are Messrs. Thomas-Jamieson & McKenzie, both of Calgary.

The Grand Trunk Pacific Railway has let contracts for the construction of buildings at four of its divisional points along its main line in British Columbia. Buildings will be erected at Endako, Smithers, Prince George and Pacific at a cost of $300,000. Twelve-stall roundhouses will be erected at each town. Contracts to build machine shops, stations and warehouses at Prince Rupert will shortly be let.

Mr. J. W. Stewart, president of the Pacific Great Eastern Railway, announces that construction is proceeding with undiminished vigor all along the route of the new line from near Pemberton to Fort George, B.C. A force of nearly 7,000 men is engaged in the task of projecting a new line into the interior. A sum aggregating between $1,250,000 and $1,500,000 is being spent each month in the work of construction.

Work on the construction of five oil tanks for the Imperial Oil Company has been commenced at Prince Rupert, B.C. The erection of the tanks will be rushed to completion. Two pump houses and a warehouse, 50 x 150 feet, will also be built. The site is located near the dry dock, and will require considerable excavating. The storage plant to be constructed at Prince Rupert for the Imperial Oil Company will cost $250,000.

The Railway Department of the Provincial Government, Victoria, B.C., have received advices that nearly a mile and a half of the preliminary shaft of the five-mile tunnel to be driven under the Selkirk Range for the C. P. R. has been excavated. On October 26, 5,014 feet had been excavated out of the pioneer bore, a small passage running parallel to the main tunnel from the western portal. Rapid progress is being made with the main tunnel, which is designed for double-track traffic. The main heading has been widened out to its full width, 2,363 feet from the eastern end of operations, and 1,256 feet from the western entrance. A section 706 feet long has been completed at the east end.

It is announced that the Grand Trunk Pacific has entered into contracts with Messrs. Carter-Halls-Aldinger Company for the construction of terminal buildings at Prince George, Endako, Smithers and Pacific, four thriving divisional points on their main line. This work will take care of a very large number of mechanics and laborers during the coming winter season. The works are to be extensive and ample for the anticipated needs of the next few years, and include roundhouses, machine shops and so forth. In addition, it is probable that a contract will be let for the works at Prince Rupert, the coast terminus, within a short time, and in further addition to these works the company are also constructing a large number of warehouses, stations and other buildings at the divisional points.

Dr. Alfred Thompson, member of the Dominion Parliament from the Yukon, who is active in the development of the district which he represents, makes the announcement that railway communication between northern British Columbia, Yukon, and Alaska will follow the completion of the Canadian Northern Pacific and the operation of the Grand Trunk Pacific Railways. It is Dr. Thompson's belief that the next great railway to be constructed in Canada will be from a point on the Grand Trunk in British Columbia through the northern part of the Province and the Yukon to connect with the system which is to be built by the United States Government in Alaska. This will open up a vast territory in northern British Columbia and southern Yukon, and give railway communication from Sydney to the boundary line of the Yukon on the one hundred and forty-first meridian west, making it possible to take a train in Vancouver and ride to the shores of Bering Sea. This will make an empire tributary to the cities of British Columbia, with Vancouver as the railway and commercial centre. The Yukon has large areas of fine agricultural land, and the gold production of the territory for the last year is estimated at $6,000,000. The plan of the United States Government to spend $35,000,000 in railroad construction in Alaska will give impetus to the building of connecting lines in British Columbia and Yukon, and will result in opening and developing much valuable territory rich in natural resources.

Book Reviews

Concrete-Steel-Construction (Part 1) Eddy & Turner, Minneapolis. This work is a treatise upon the elementary principles of design and execution of reinforced concrete work in buildings. The authors point out that the fire losses in Canada and the United States amount annually to half a billion dollars and that the question of economy governing the type of construction it is a matter of the greatest importance to determine whether safe fireproof buildings can be built at practically no greater cost than combustible ones. In their book the authors discuss the practical problems of reinforced concrete, and treat at length the restraint imposed upon the elements of the composite structure, so that rational rules may be adopted for the safe and economic design of this type of fireproof building. The following statement is borne out by the experience of many Canadian towns and cities: "Failure on the part of the engineering profession to consider these laws in drawing up building codes has led to grave errors, thereby offering a premium on the more dangerous types of designs in concrete building work, and placing at a disadvantage the more scientific, safe, and conservative types of work as determined by the records of these types in practical construction." Patented as well as unpatented types are discussed, and engineers cannot fail to find special interest in the treatment of steel ratios and flat slabs by the theory of work and in the section devoted to reinforced concrete columns. The book contains upwards of four hundred pages and is illustrated by numerous halftones and diagrams.

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Alphabetical Index of Advertisers
Page 18

Vol. 28 November 25, 1914 No. 47

Principal Contents

Page
British for British ... 1421-2
The Effect of Unbalanced Building Codes ... 1423
Reinforced Concrete in Municipal Engineering Work 1423-4
Corrosion of Steel in Concrete ... 1424
Causes of Concrete Failures ... 1424
Proposed Water Storage on the Upper St. Maurice River, Province of Quebec ... 1425-7
By John Wolf Thurso
Hammer Drill Used in Cutting Pavement with Concrete Base ... 1427
An Eleven-Mile Lumber Flume in B. C. ... 1428
Bonding Asphalt to Concrete ... 1428
The Engineer as a Factor in Modern Warfare ... 1429-30
The Field of the Slow Sand Filter ... 1430-1
English Specifications for a Bituminous Concrete Mixing Plant and Details of the Acceptance Test. 1431-2
Bricklaying Costs for 5 to 10-ft. Brick Sewers at St. Louis, Mo. ... 1432
By C. L. French
Comparative Costs of Three Types of Foundation Construction ... 1433
The Value of System in Contract Work ... 1434-5
By G. Crain, Jr.
Securing Good Work from Men ... 1435
The Hennibique System of Ferro-Concrete Construction ... 1436-40
New Residence for Students of the University of Saskatchewan ... 1441
Cracks in Concrete Roads ... 1442-3
A Large Trussed Concrete Bridge ... 1444
Concrete Roads—Their Design, Specifications and Present Status ... 1445-7
By A. A. Young
Personal Mention ... 1448
Constructional News ... 1448-9

British for British

If one were asked to give an example of the new avenues of trade which the war has opened up to the Canadian manufacturer, one could hardly cite a better instance than the supply of iron and steel goods. It is interesting to recall that during the fiscal year ended March 31 last, iron and steel goods imported into Canada from Germany amounted in value to $3,000,000, or nearly one-fifth of the total import of German goods into the country. A great assortment of goods goes to make up this amount. Tubing to the value of $539,000 and steel tires for locomotives to the value of $348,000 are included, as are also machinery to the value of $253,000, angles and beams to the value of $185,000, tools and implements worth $67,000, etc. A good slice of this trade should come to Canada and it rests with our iron and steel manufacturers to obtain and hold it.

We must not run away with the idea that the trade which the enemy countries have enjoyed with us will come to our manufacturers without the asking. There are keen competitors in the field—notably our friends on the other side of the border, who are displaying much enterprise in the matter of following up opportunities for new business at this time.

In the United States the various associations have had experts at work sizing up every phase of business changes and laying plans for the greater adoption of American-made products. As a single instance we recall an article in a Chicago publication setting forth the possibilities of introducing American-made pianos into Australia. The impression on the other side of the border is that the withdrawal of German competition in various lines of manufacture leaves the United States and Great Britain in possession—with all the advantages resting with the former, owing to the partial paralysis of British industries resulting from the war.

One cannot but pay tribute to the enterprise of our "American cousins," but we should benefit from the example they have set us and not pass up the opportunities which will be within our grasp only for a short time. Let it be remembered that the great bulk of Canada's purchases in Germany in the past have been comprised of finished manufactured products and that before the outbreak of hostilities trade was increasing rapidly. The war is a drastic measure of readjustment, but as a matter of cold fact it cannot but provide a stimulus to Canadian industry. Germany has been sending to Canada considerable quantities of iron and steel goods, hardware, electrical apparatus, scientific instruments, earthenware, glassware, etc., and it is now for the Canadian manufacturer to replace the German product. This can only be effected by great application and considerable enterprise, the combination of which cannot fail to promote the welfare of Canadian industry—moreover, in some lines the status of the industries will tend to a higher plane, as in certain lines—such as scientific instruments—where minute execution and exactness of finish are required, German manufacturers have established a reputation for careful and thorough workmanship. If there be a redeeming feature in the German character, it is the thoroughness with which the nation has improved its position in certain lines of manufacture during the last generation.

One may rest assured that in our day and generation there can be no recognition of German industry and that any German-made article will spell anathema to all self-respecting Britishers. British manufacturers the world over must combine to see that the trade suicide to which Germany has committed itself is executed to a finish; further, they should see that as far as possible German imports are replaced by British products.

Canada's situation is such that it must always be identified more or less closely in trade with the United States, and it is in the best interests of both countries for an interchange of trade to be maintained—indeed in many lines, particularly in the constructional field, we are yet dependent upon United States foundries; but in spite of this the principle of "British for British" must have loyal recognition from now on, even at the price of some self-sacrifice. The vain boast of "Deutschland uber alles" must give place to a world-wide recognition of British superiority in the whole category of human activities, in which manufacturing is one of the greatest considerations.

The Effect of Unbalanced Building Codes

THE lack of uniformity in the provisions of the building codes of cities in various parts of the country has resulted in an increased cost of construction for certain types of buildings, comments Engineering & Contracting, editorially. In one city the building code may specify low working stresses for reinforced concrete and comparatively high ones for steel construction, and vice versa, which naturally results in a preponderance of one type of construction almost to the exclusion of any other type. This condition limits competition to those engineers and contractors who specialize in only one kind of construction, and thus increases the cost of building construction in general. Monopoly, as applied to any kind of business, tends to increase costs to the consumer, and the construction business is no exception.

The need of more nearly balanced building codes—codes which do not unduly favor a certain type of construction—are greatly needed in many cities. The unit stresses which should be permitted are not a function of the particular part of the country in which the city happens to be located, yet a comparison of many codes might lead one to believe that such is the case. The officials of cities are not best serving the interests of these cities when they do not make determined efforts to secure balanced building codes.

To emphasize the importance of the above remarks the building status of an important eastern city will be considered briefly, the name of which is not pertinent to this discussion as similar conditions can be found in other cities. Although the following comment applies particularly to reinforced concrete construction, it may apply with equal force, in some other city, to another type of construction. In this particular city the extreme fiber stresses in concrete and steel are respectively 500 lbs. per square inch and 15,000 lbs. per square inch, the ratio of the modulus of elasticity of steel to that of concrete being 15, while the bending moment factor for intermediate spans is WL/10. It will be noted that these requirements are much more rigid than those of most large cities in this country. As a result, preference has been given to other types of construction, and the cost of reinforced concrete construction in this city is almost prohibitive. Capital is placed at a disadvantage, as compared with other cities, and the great progress of the city has been retarded. Even though this city requires the building public to adhere strictly to the provisions of its building code, yet the city itself, through its various departments, uses unit stresses of 650 lbs. per square inch in concrete and 16,000 lbs. per square inch in steel. It is thus seen that private capital is compelled to pay a bonus for this type of construction, although the city officials, in making public improvements, use the higher unit stresses.

Many of the provisions of building codes, notably those specifying allowable unit stresses, should be settled definitely by a commission composed of leading authorities in this country—men who will consider the subject broadly and who do not need to cater to the interests which are strongest in each city. The fact that the building codes of many cities are unsatisfactory is due mainly to the mistaken idea which has long existed that each city must solve its problems in its own way, which generally means that the strongest interests in each particular city are favored.

Reinforced Concrete in Municipal Engineering Work

SOME interesting observations anent the application of reinforced concrete to municipal engineering enterprises were made in the course of a lecture delivered recently in London by Mr. E. R. Matthews, Chadwick Professor of Municipal Engineering in the University of London. Prof Matthews remarked that the material was not a new one. Its discovery was claimed by the Germans, who, however, claimed many things which they had no right to do. Actually it was used one hundred years B.C. by the Romans in the covering of the roofs over their large tombs. The reinforcing material they employed consisted of bronze rods, but the concrete, they might be sure, was very poor compared with what we used to-day. About sixty years ago the French people took up the material very earnestly, and at the Exposition of 1867 there were a number of exhibits of reinforced concrete work. Since then the Germans had used a great deal of it. But America had been the leader; no country had used more, and the material was growing in favor as a result of the experience which had been gained. It had been used there for all sorts of purposes—often when it was inadvisable.

British engineers seemed to be rather conservative in their ideas with regard to adopting any new material, and it was some time before they looked upon reinforced concrete with favor; municipal engineers were now, however, commencing to use it a good deal. Some isolated cases of corrosion of the reinforcement had resulted in certain engineers refusing to employ it. He might say, however, that some years ago he carried out tests with a number of blocks of reinforced concrete about 1 ft. cube in size. Some of these were put in the sea at low water, others in fresh water, and a third set were left in the open air, and in no case did he find the least corrosion; in fact, reinforcing bars which, when put into the concrete were covered with red rust, when taken out were found to be quite bright. He once had occasion to take off the roof of an underground lavatory which leaked badly. The steel joists of this were embedded in concrete, but the bars showed no signs whatever of corrosion. He had found the same thing in a sea wall which he had to repair, and he thought such experiences tended to strengthen one's confidence in reinforced concrete. Corrosion did not bother him a bit, if the concrete was properly mixed and the reinforcing bars were thoroughly covered. He wished at the same time to utter one word of warning. Cinder concrete must not be used for reinforced concrete work, his experience of that being that, owing to the chemical action that was set up, corrosion occurred.

Prof. Matthews went on to refer to the use of reinforced concrete in the construction of sewers and aqueducts. Proceeding to deal with its advantages, he remarked that no material could be constructed more rapidly, the cost of maintenance was low, expansion and contraction were practically the same, and, of course, the concrete did not deteriorate, but increased in strength with age. He hoped the time would come when municipal engineers would adopt it more extensively, because he believed it was possible by its use to effect a saving o ffrom 20 to 30 per cent.

Corrosion of Steel in Concrete

SPEAKING on this subject some time ago, Dr. W. H. Walker, Director of the Research Laboratory of Applied Chemistry, of the Massachusetts Institute of Technology, said that every engineer is well aware of the fact that acidulated water, no matter how small the percentage of acid may be, tends to corrode steel by increasing the number of hydrogen ions present. It had been made clear, from tests he carried out, that there were certain alkaline substances present in concrete which corrected any acidity, and so protected the contained metal work from corrosion. This fact has an important bearing upon the question whether concrete will protect iron or steel from corrosion. Inasmuch as Portland cement, when it sets or hardens, liberates a quantity of caustic lime, which is a strong alkali, the answer to the question must be in the affirmative. Iron or steel will not corrode when embedded in good concrete. But caustic lime is soluble in water, and poorly made concrete is not impervious to moisture. Therefore, if iron be embedded in concrete through which water is allowed at any time to percolate, this calcium hydrate will be slowly but surely dissolved. With it will disappear the inhibiting action of the concrete; and iron embedded therein will, in time, rust and become corroded. To ensure absolute protection of the reinforcing members of concrete construction, therefore, such concrete must be of good quality, and sufficiently dense and carefully made to render it waterproof.

Disastrous fires at the docks along the Seattle water front have led to an ordinance providing that all docks constructed hereafter shall be provided with fire walls spaced not farther apart than 500 ft. on centers and firestops not more than 100 ft. apart. These provisions are not required in structures fully equipped with automatic sprinklers.

Causes of Concrete Failures

AT the recent annual meeting of the American Society for Testing Materials, Mr. R. S. Greenman discussed the causes of failures in concrete work. In classifying the reasons for failures, he said that of the known examples of poor concrete work 90 per cent. were due to poor workmanship, 8 per cent. due to poor aggregates, and 2 per cent. due to poor cement. He said further that "these reasons, and the additional one of the influences of the water used, are responsible for most failures."

From the nature of the subject under discussion, it is obvious that it is impossible to set exact percentages for each contributing cause to failure which will hold true for concrete work in general; yet approximate percentages may prove useful as a basis for determining the cause of any specific failure. In fixing the percentage due to poor workmanship, this value should undoubtedly be high, yet it is difficult to define what is meant by "poor workmanship" and what constitutes "good workmanship." What may be considered good workmanship for one type of structure (because it results in safe and economic construction) may not be satisfactory for a different structure. It is undoubtedly true that for most structures sufficient care has not been taken in the making and placing of concrete. When the essential element "time" is considered, it is probably true that concrete has not been given a fair trial. Concrete is usually made and placed at the site, yet these two distinct operations are made to compete with the erection, only, of other types of construction. Owing to this fact, it has been found impracticable to give concrete construction adequate inspection from start to finish. If sufficient time and care were given to the competent inspection of concrete structures, the 90 per cent. weight given to "poor workmanship" would be much too high.

Under present conditions, as pointed out by Engineering and Contracting, the 8 per cent. rating given to poor aggregates is probably too low. We are just beginning to realize the great difference that exists in the aggregates which ordinarily are available for concrete. As a rule, insufficient care is given to the inspection and testing of sand, broken stone, and gravel. Unfortunately we still find specifications which merely require that the sand shall be "sharp" and "clean"; yet tests have shown that "sharpness" is not essential, and that a small percentage of foreign matter is not particularly objectionable, provided it does not form a coating on the grains. More care is needed in the inspection of broken stone and gravel, while standard methods of testing these materials are needed.

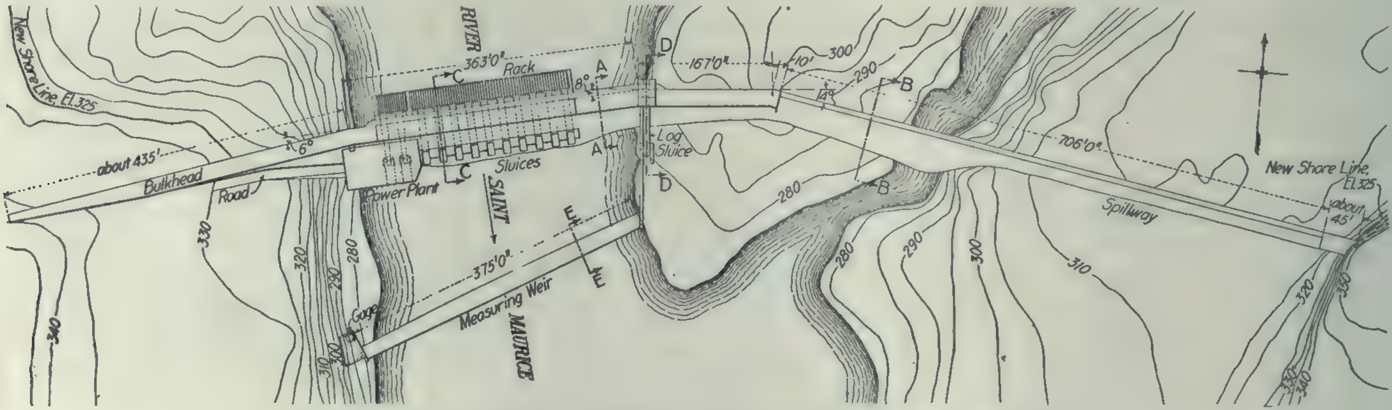
Although a careful examination of failures will usually determine the cause of failure, what is more generally needed is a better appreciation of the good results which will follow from increased attention to the selection and proportioning of concrete mixtures and to the mixing and placing of concrete. We believe that the lessons to be drawn from a study of existing failures will emphasize, mainly, the importance of factors which are (or should be) commonly understood by those now in charge of concrete construction. For example, the continued practice of specifying a definite concrete mixture, without first determining the properties of the aggregates and the proportions which will give a mixture of maximum density, is not justified by facts.

Proposed Water Storage on the Upper St. Maurice River, Province of Quebec

Main Features of Reservoirs of 160,000,000,000 Cubic Feet Capacity to Regulate the Flow of the River

By John Wolf Thurso, Civil and Hydraulic Engineer, Montreal

A CONCRETE dam to store the run-off from a basin of 3,650 sq. miles is to be built on the upper St. Maurice River in the Province of Quebec. Several years ago the St. Maurice Hydraulic Co. was formed by a number of companies owning and using water-powers on the St. Maurice River and by companies engaged in log driving on that stream. The object of the company was to regulate the flow of the river, specially to increase the low-water flow. Three timber dams have been constructed on the Manouan, a large tributary of the St. Maurice, forming reservoirs with a combined surface area of 100 square miles and a total capacity of 16,000,000,000 cu. ft. When the company applied to the Provincial Government for permission to create storage reservoirs of a much larger size on the St. Maurice River itself the matter was referred to the Quebec Streams Commission. The Commission advised that the government should have control of all such reservoirs, as there are quite a number of undeveloped water powers on this river not represented in the St. Maurice Hydraulic Company. In December, 1912, the commission was authorized to prepare plans, specifications and estimates, subject to approval by the government, which approval was obtained in December, 1913.



Plan of dam, showing relation of bulkhead, power plant, sluice gates, log sluice and spillway.

Hydrographic Conditions

The river has a drainage area of 17,000 square miles. It flows in a southerly direction and debouches into the St. Lawrence at the town of Three Rivers. The annual precipitation averages about 35 in. and the run-off averages 1.75 sec. ft. per square mile, or 67.9 per cent. of the precipitation. The dam site chosen is approximately 240 miles from the mouth of the river. The drainage area above that point is 3,650 square miles and the total fall from the site to the mouth is 1,278 ft. During the first year that records have been kept (May 1, 1913, to April 30, 1914) more than 170,000,000,000 cu. ft. of water have passed the site.

In 1912 the commission sent survey parties to ascertain the height to which a storage dam could be built without danger of spilling over into adjacent watersheds and to determine the capacity of the reservoir for such maximum height of the dam and the amount and quality of timber land to be flooded.

Three dam sites were investigated, the one finally chosen being 2.3 miles above La Loutre Rapids. To facilitate construction, a point where the river is divided by an island was chosen. This site is about 35 miles from the nearest point on the National Transcontinental Railway and about 50 miles upstream from the village of Manouan, where the Manouan River empties into the St. Maurice. Between the site and this village are seven rapids with a total fall of more than 115 ft., thus making river transportation of construction materials impossible. The whole country is extremely rugged. There are no roads. From the railroad the dam site is reached in summer by canoe with seven portages and in winter by dog sled. By either means the single trip takes two days.

The geological formation of the site and of the drainage area above is a gray Laurentian gneiss interspersed with (usually thin) layers of black hornblende and mica, the strata having a dip of about 45 deg. Here and there are small outcrops of a flesh-tinted granite. The whole surface is much eroded by glacial action. When the top soil is removed from the bedrock the glacial scratches are plainly visible and in some places numerous potholes are to be found.

In the spring of 1913 O. Lefebvre was appointed chief engineer and De S. Beaudry resident engineer, and a more exhaustive study of the location was started, consisting in clearing it of timber, digging trenches and test pits, making soundings of the river and core-drilling in the river bed. As expected from the geological formation, the bedrock proved to be of excellent character—hard, impervious and free from seams.

For the top of the dam and spillway crest El. 335 and 325 respectively were adopted, with provision for flashboards to El. 328. The lowest place in the river bed under the future dam body is El. 254. The zero datum for these elevations is 1,000 ft. above sea level.

Above the dam is a chain of lakes, with a present surface area of 209 square miles. Raising the level from El. 278—the present low water at the dam—to

El. 325 will cause the flooding of 95 square miles of land, bringing the reservoir surface to 304 square miles, with an available capacity of more than 160,000,000,000 cu. ft. With the water level at El. 328 (top of flashboards) the available capacity will exceed 185,000,000,000 cu. ft. It is not assumed, however, that the reservoir will be filled every year to its utmost capacity.

The three reservoirs on the Manouan are to be taken over by the Provincial Government and operated in conjunction with the La Loutre reservoir.

Design Considerations

In the design of the work the conditions were as follows: A reservoir was to be created having a capacity at least twice as large as the famous Assuan reservoir in Egypt, which since the recent raising of the dam has a capacity of about 80,000,000,000 cu. ft. The dam would be in a locality where the temperature drops to minus 60 or 70 deg. Fahr. and the range is about 160 deg. An ice sheet at least 3 ft. thick and the corresponding expansion forces must be reckoned with. The site is in the wilderness, 50 miles from the nearest settlement and at times almost inaccessible. It would, therefore, be difficult to obtain good men for the small staff of five or seven men required for operating the works, while, on the other hand, it would be impossible to keep them under proper supervision from the commission's offices. For this reason everything should be as nearly fool-proof as possible, and machinery and apparatus liable to breakdowns should be installed in duplicate.

The first matters to be considered were the assumptions on which the design of the dam body was to be based. Five different types were investigated and estimates made.

Almost nothing of practical value has been published in regard to ice pressure, but a fact brought out by G. G. Bell before the Maine Society of Civil Engineers in 1911 was that a sheet of ice, when frozen to the sloping deck of a dam, will exert its full force upon that deck and will ultimately crush in the body of the ice, instead of shearing along the deck surface, no matter what the angle of slope of the deck may be.

It has been decided that the sluice gates should have a maximum capacity of 18,000 sec.-ft. under a head of 8 ft. This quantity is only to be fed out when a log or ice jam is to be broken or a belated log drive, stranded in some shallow spot in the river, is to be floated off. It was also determined that there should be an open sluice way reaching down 30 ft. below the spillway crest, to be used for passing logs and floating rubbish through the dam, and that provision should be made for a fishway.

General Design

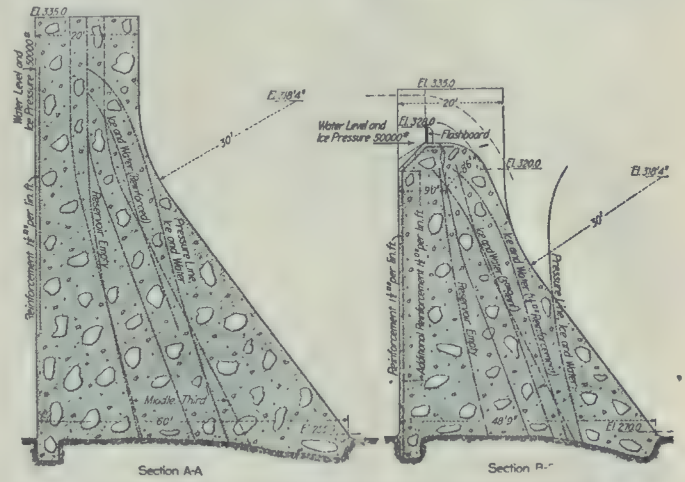
The east and west ends of the dam were swung downstream in order to shorten the structure and bring the line of the dam at right angles to, and the gate tunnels parallel with, the direction of the river. This left 167 ft. of the dam on the island on the original line. The extreme western end was later swung still further downstream, as investigations had shown that bedrock was to be found at a higher elevation along this final line.

It was decided that a solid concrete dam would be best and that an ice pressure of 50,000 lb. per linear foot applied at the elevation of the spillway crest should be assumed, while the uplift under the dam might be neglected. As the pressure line for this profile of the bulkhead section adopted falls outside the middle third, 1-in. square twisted bars were added near the upstream face to prevent a failure similar to those at Bouzey, France, and Habra, Algiers, both of which dams snapped off at about the middle of their height. The spillway and the sluice-gate section were similarly reinforced.

For all concrete a proportion of 1:2½:5 was adopted, large stones to be embedded in all work of sufficient dimensions to permit this. Soft steel, brought by twisting to about the strength of medium steel, was chosen for the reinforcement and a permissible stress of 16,000 lb. per square inch was assumed.

The demanded sluice-gate capacity required a total gate opening of 900 sq. ft., obtained by providing ten gates 7½ x 12 ft. placed 20 ft. on centres.

Below the dam a measuring weir will be built. It will be placed at an angle with the dam to obtain a greater length of crest and form an approximate right angle with the direction of the river. The most important object, however, of this weir is to form a water seal for the gate tunnels, as in winter the gate leakage would otherwise freeze in the tunnels and choke them with ice. The weir will also keep the water up to the turbine draft tubes and form a water cushion to absorb the speed of the discharged water, which at the gate end of the tunnels will be about 55 feet when the reservoir is full. The weir crest is at El. 278 (summer low water) so that it will usually be submerged. It will still be easier to measure the quantity discharged from the reservoir by thie weir than by the amount of gate opening, owing to the varying water level in the reservoir.


El. 335.0
20'
Water Level and Ice Pressure 50000#
E. 318'4"
30'
Ice and Water (Reinforced)
Reservoir Empty
Pressure Line Ice and Water
Reinforcement 1☐" per lin. ft.
Middle Third
60'
Section A-A
El. 335.0
20'
Water Level and Ice Pressure 50000#
El. 328.0
Flashboard
El. 320.0
El. 318'4"
30'
90'
Reinforcement 1☐" per lin. ft.
Additional Reinforcement 1☐" per lin. ft.
Reservoir Empty
Ice and Water (Reinforced)
Pressure Line Ice and Water
48'9"
El. 270.0
Section B-B

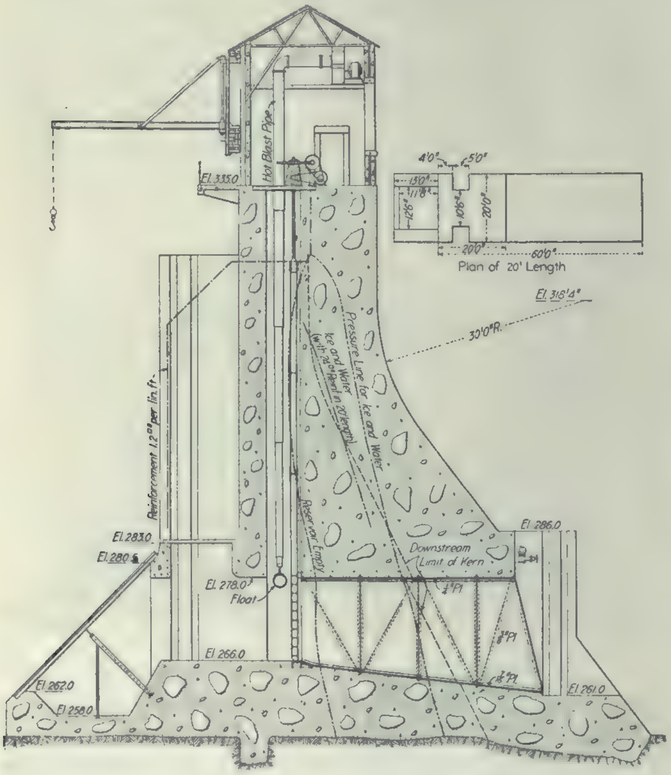
Typical sections of bulkhead and spillway portions of dam.

A spillway length of 696 ft. (fifty-eight 12-ft. flashboard sections) was adopted in order to confine the spillway discharge to the east channel and avoid carrying floating rubbish into the basin above the measuring weir. With 6 ft. of water over the flashboards the spillway discharge would be about 35,000 sec.-ft., while the ten gates could discharge about 45,000 sec.-ft. The spillway is, therefore, only an extra precaution. The only spring-flood measurement available shows a maximum flow of 14,500 sec. ft.

Especially during the first few years it is expected that a large amount of floating matter will be brought down from the flooded timber lands. To get rid of this, an open sluice is to be provided, with a steel channel, the upstream end of which is adjustable to the water level in the reservoir. This channel will also be used for floating logs through the dam, and if a fishway is required temporary wooden steps may be placed in it and a wooden extension added to its downstream end reaching down to the water level.

The power plant is to furnish current for lighting, and for operating the sluice gates, jib cranes and fans, but especially for generating heat. As the cost of coal would be at least $25 per ton at the site, and cordwood from the drainage area above the dam would not be dependable, it was decided to do the heating by electricity. Turbines not only require less attendance than boilers, and as water has to be fed out anyway in winter, there will be no waste of water by utilizing a small part of it for the development of power.

There will be two double-runner turbines of 180 h.p. each under a minimum head of 15 ft. and running at 200 r.p.m. One is a spare unit. As the head on the turbines may rise to 50 ft., and the power-house floor had to be kept 8 ft. above the crest of the measuring weir, or at El. 286, trouble with the draft tubes is to be expected, especially with small loads on the turbines. To obviate this the lower end of each tube is to be provided with a butterfly valve, so that the total head may be throttled down to 15 or 20 ft. effective head. The valve is hand operated, while the speed of the turbines is regulated by oil-pressure governors.



Section through one of the sluices, showing heating conduit.

Two return tubular boilers 60 in. in diameter by 16 ft. long will be provided to carry a steam pressure of 125 lb. They will have grates arranged for burning cordwood. The reinforced-concrete chimney curves along the downstream face of the dam and extends 40 ft. above its top. A vertical, cross-compound, non-condensing engine, with a maximum output of 180 h.p. and running at 300 r.p.m., is to be placed at the end of the line shaft and connected thereto by a friction coupling.

The line shaft, running at 300 r.p.m., is supported by concrete bases and so arranged that it can receive power from either turbine or the engine and transmit it to either generator. These generators each have a capacity of 100 kw. with an overload capacity of 25 per cent. for 2 hours; they run at 500 r.p.m. and generate direct current at 250 volts. One of the generators is a spare unit. Power from the turbines and to the generators is transmitted by Renold's silent chains submerged in oil-bath gear cases. A 5-in. vertical centrifugal pump set into a pit is provided to pump out the gate tunnels for inspection or repairs.—Engineering Record.

Hammer Drill Used in Cutting Pavement with Concrete Base

INFORMATION as to the use of a hammer drill in breaking up pavement having a concrete base is supplied by J. H. Henning, Salt Lake City, in Engineering and Contracting, as follows:

On an asphalt pavement repair job in progress in Salt Lake City, Utah, the contractor, J. P. Moran, has been using a hammer drill for this purpose. The economy of the use of a tool of this kind when working along a street car track, where a picking gang is subject to constant interruption by passing street cars, is apparent.

The method used in making these cuts was as follows: A line marked one foot from the car tracks was channeled through the asphalt with a Sullivan DC-19 drill operated by one man, a special fan-shaped channeling bit being used. When a sufficient distance had been channeled a gadding bit was substituted and the asphalt removed from the concrete base. The exposed concrete base was broken up with the same bit, holding the machine in a nearly vertical position. The concrete was broken into pieces from 4 in. to 8 in. square, which were readily thrown out by hand or removed with a shovel.

The drill broke up an average of 1 sq. ft. of asphalt and concrete in 2½ minutes. By the old method three men with sledges and picks averaged 1 sq. ft. in 6½ minutes, or 19½ minutes per man per sq. ft. removed.

The drill was operated by steam obtained from a compressor mounted so that it could be dragged along the street and supplied with steam by a portable boiler.

A rough estimate of the cost of similar work, using slightly different equipment and a comparison with hand labor costs, is given below:

Machine Work		
Cost of plant, including one "WK-3" 20-h.p. portable air compressor, operated by gasoline engine and two "DC-19" hammer drills, hose, steel, blacksmith tools, etc., about	$2,000.00	
Interest on plant, at 6 per cent.	120.00	
Depreciation, 15 per cent.	300.00	
Total plant expense per year	$420.00	
Operating expense, 175 days per year, (per day $420 ÷ 175)	2.40	
Engineer's wages per day	3.50	
Two drill operators, at $2.50 each	5.00	
Gasoline, 20 gals. at 23 cts.	4.60	
Oil, waste, etc.	.50	
Daily cost of operating	$16.00	
Progress per day of 8 hours, 384 sq. ft.		
Cost per sq. ft.		$0.0416
Hand Work Cost		
Six laborers at $2.25 per day	13.50	
Progress per day, 8 hours, 144 sq. ft.		
Cost per sq. ft.		.0937
Saving in cost per sq. ft., by use of portable air compressor and hammer drills		$0.0521

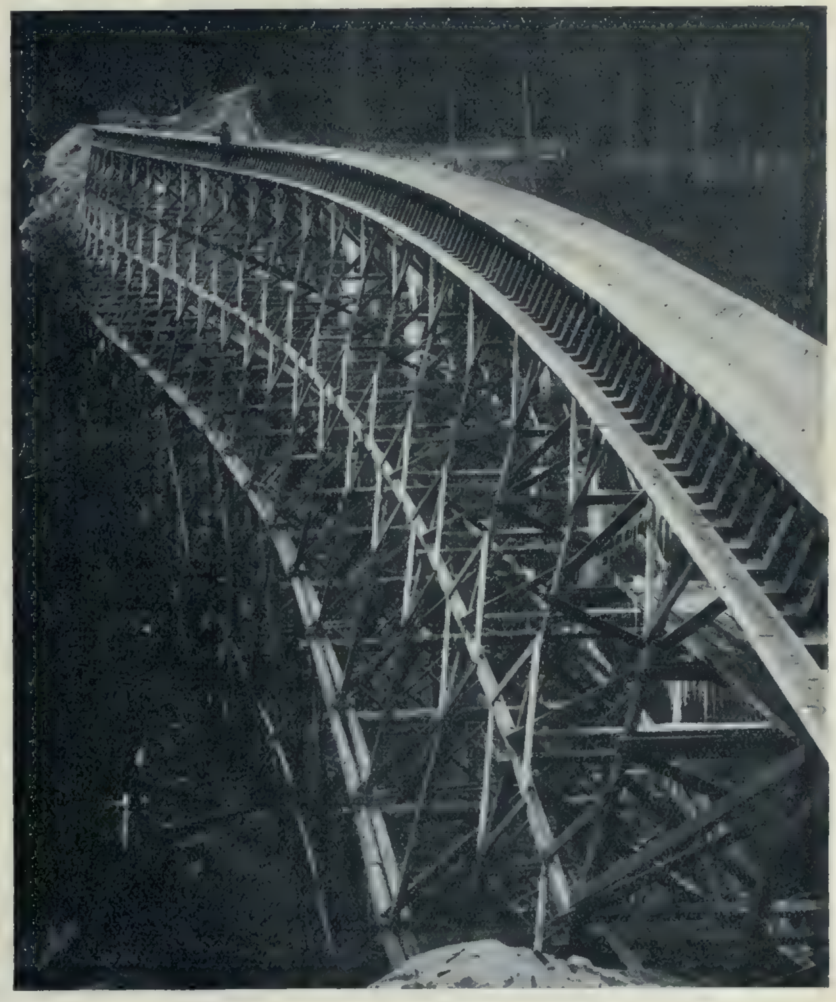
The annual report of the Water Commissioner of St. Louis states that there are comparatively few leaks in the concrete pressure conduit, which is 1,885 ft. in length and 7 ft. in diameter, which led from the basins to the pumping station at the Bessels Point water intake in St. Louis. All concrete used for repairs is of gravel with cement and sand in such proportions that one sack of cement produces 4½ cubic feet of concrete; 12 lb. of hydrated lime are added to each sack of cement, and the mixture is retained in a batch mixer for three minutes.

An Eleven-Mile Lumber Flume in B.C.

For the transportation of lumber from otherwise inaccessible districts in the logging regions, the Adams River Lumber Company, Limited, of Chase, B.C., have under construction a flume which, when complete, will be eleven miles in length. This flume, an illustration of which is given herewith, will tap a recently acquired timber berth of about 25,000 acres. At the present moment the flume has been constructed for a distance of about eight miles and it is reasonable to add that its operation will be an important asset to this enterprising lumber company. Among the advantages to be gained by its use are better facilities for the economical transportation of logs from this limit than have been at the disposal of the company from its old limits on Upper Adams River. Another outcome of the arrival of the flume is the elimination of the drive on Lower Adams River which will follow as a result.

The maximum curvature of the flume will be 10 degrees. The grade will vary from 2/10 to one per cent., where the flume leaves the head works on Adams Lake, to a maximum of 16 per cent. in Bear Creek Canyon. The curves have been held down to permit the transportation of 80 to 100-ft. poles and piling. Most of the timber will be handled direct into the flume from log chutes. The flume will be extended into the timber as it is logged, in much the same way as logging railways are extended to follow the cutting. The erection of the flume is under the supervision of Mr. W. D. Starbird, of Spokane, Wash. The section shown in the illustration was constructed by Mr. J. H. Tracey, the firm's woods superintendent.

The Adams River Lumber Company have also constructed a dam which creates two small lakes to supply a head of eight feet of water for fluming purposes. It is said that as a result of the opening up of the new limit, about one-half of the output of the company's saw and planing mills is now fir, the balance being cedar, spruce and pine.



A part of the eight-mile flume of the Adams River Lumber Company.

A good-sized irrigation undertaking in Texas will be placed under contract on December 1. The work is to be done for the Ward County Irrigation District, of Barstow, Tex., and will include the construction of about 40 miles of canal and about 15 miles of levee, the building of a dyke or levee at the reservoir site and the construction of two dams in the river, head gates, sluice gates, etc. The contract work will amount to about $325,000. The contract will be let with the provision that the successful bidder shall purchase the bonds of the district.

Bonding Asphalt to Concrete

Among the several problems to be met in the recent construction of the concrete reservoirs in San Francisco was that of bonding asphalt to concrete. According to Mr. B. N. Abbott, after making unsuccessful attempts to apply the asphalt direct to the concrete in various ways, the expedient of first painting the surface with coal-tar was tried, and it was found that when applied in this way under right conditions the asphalt would adhere so firmly that after it had cooled it could not be broken away without bringing pieces of concrete with it. Mr. Abbott states that in order to secure this result the concrete surface was first scrubbed clean with a bristle brush, and over this a thin coating of hot coal-tar was "painted." The coal-tar should be heated in small quantities, brought just to the boiling point, and then applied immediately. Heating the coal-tar in large quantities, which necessitated some delay before it could all be used, did not give such good results, and the men were, therefore, not allowed to heat more at a time than they could apply quickly as soon as it began to boil. The asphalt was spread over the tarred surface in the usual manner.

A 14-mile tunnel through the Caucasus mountains has been proposed by a Russian committee. This tunnel would shorten the distance between Waldikawkas and Tiflis by about 90 miles.

The Engineer as a Factor in Modern Warfare*

(An article in which Lt.-Col. Jos. E. Kuhn, Corps of Engineers, United States Army, discusses the organization, duties and equipment of the technical troops of the German army under actual service conditions.)

WHILE the titanic struggle now raging in Europe is engaging the attention of the whole world, it may be of interest to learn a little of the part played in military operations by the engineer's art. In a matter so serious as war, involving the very existence of states, it is inevitable that advantage will be taken of every resource of the arts and sciences and that engineering must obviously play an important role. In fact, the very character of warfare is profoundly affected by the achievement in the several fields of engineering. To cite a few instances only, warfare on the scale now witnessed in Europe would be impossible without the transportation facilities of the railroads and of mechanically propelled vehicles, nor could such enormous masses of troops be directed and controlled by one master mind without the aid of the telephone, telegraph and wireless. The achievements in metallurgy and machine design have produced the modern gun and rifle which have profoundly influenced battle-field tactics.

Classes of Technical Troops

It must be plain that the engineer's art plays no inconsiderable role in the equipment and transportation of armies, but the part played during actual campaigning, with its incidental marching and fighting, is perhaps not quite so apparent. Briefly stated, campaigning consists in overcoming obstacles, sometimes natural, but more often due to the enterprises of the enemy. On the march the principal obstacles are poor or impassable roads; in battle it is the fire of the enemy. While it is the duty of every soldier, irrespective of his branch of service, to assist in overcoming the obstacles encountered in campaigning, certain obstacles can best be met by men with technical training and technical equipment. To meet this situation, the organization of all modern armies provides for contingents of technical troops. These technical troops are frequently differentiated as pioneers, pontoniers, railway troops, telegraph sections, etc., according to the special technical work entrusted to them.

In the German Army, which may be taken as an example, the various technical duties in time of war are divided between two classes of troops, one the corps of pioneers and the other the communication troops (Verkehrstruppen). The former are strictly combatant troops, who march and fight with the infantry, cavalry and artillery. The latter have charge of the railways, telegraph, aircraft and mechanical transport in the immediate sphere of military operations. As the limits of this article will preclude any extended description of the duties, equipment and organization of all the different classes of technical troops embraced in the German military system, only the pioneers will be further considered.

Organization and Equipment

To each army corps, which is the largest permanently organized unit, there is assigned normally one pioneer battalion of 250 men. One company is attached to each of the two divisions constituting the corps, while the third company is under the direct orders of the corps commander. All pioneer companies are armed and equipped as infantry in addition to which each man carries on his person a portable work tool, there being 45 picks, 110 shovels, 58 axes, 22 hatchets with a few other tools to each company. Besides the portable tools carried by the men each company has a four-horse tool wagon carrying an assortment of digging and cutting tools and a varied assortment of supplies, such as rope, wire and nails and a two-horse demolition wagon carrying about 900 lb. of explosive.

Additional equipment for the use of the pioneer companies is found in the bridge trains accompanying each division and corps of the army, the personnel of which is furnished from the train, except that the corps bridge train has attached to it a detachment of pioneers for the care of the equipage. The divisional bridge train comprises 15 wagons carrying pontoons, trestles and flooring, sufficient for constructing 35 yd. of bridge. The corps bridge train comprises 34 wagons for carrying bridge equipage, sufficient for 136 yards of bridge. By combining the material of the divisional and corps bridge trains each army corps of about 25,000 men has sufficient material for the construction of 208 yards of normal bridge. The bridge trains do not ordinarily march with the pioneer companies but form part of the divisional and corps trains, being brought up when occasion requires.

Still further technical equipment for the use of the pioneers consists of the searchlight sections attached to each army corps. The latest pattern of searchlight equipment is a horse-drawn electrical projector carriage, the motor and generator being carried over the front axle and the projector with its telescopic mast and cable reels being carried over the rear axle. When in use the projector axle is uncoupled from the generator axle, enabling its light to be set up at any point within a radius equal to the length of cable.

In addition to the foregoing normal organization and equipment of pioneer troops for army corps and divisions special fortress and siege units of pioneers are formed on mobilization as occasion requires. These units are ordinarily regiments of two or three battalions equipped with a pioneer siege train carrying intrenching, mining and other tools, building materials, electric searchlight plant, explosives and storming apparatus. The organization of the siege train varies with the nature of the operations in view.

The recent tendency in the German Army is to increase the proportion of pioneers assigned to corps and divisions and certain corps have already had their contingents of pioneers doubled, being provided with a regiment of two battalions.

The pioneers are selected from recruits possessing a knowledge of mechanical trades such as carpenters, smiths, masons, miners, riggers, or such as have knowledge of boating and boat building, the latter in view of the importance of bridge operations. The period of training of the pioneers is two years, the same as that of the infantry. Besides being well grounded in the duties of an infantry soldier, the pioneers are thoroughly taught their special technical duties, the principal of which are bridge building, fortifications and demolitions.

The crossing of an unfordable stream in the face of opposition by an enemy is one of the most difficult and dangerous of military operations and one in which the pioneer plays a most conspicuous part. Upon his technical skill, nerve and daring depends the success of an attack or the safety of a retreat, and when the undertaking is handicapped by swift currents and by the fire of the enemy, the pioneer's task is indeed a most trying one. In European terrain, intersected by numerous streams and canals, bridging operations are of common occurrence in campaigning and, even if there were no other engineering features in war, these operations alone would call for technical troops and equipment.

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* Abstracted from the Engineering Record.

During an advance a section of pioneers always marches with the advanced guard to repair or improve roads and to remove obstacles created by the enemy. During an attack, especially on fortified positions, pioneers accompany the advance of the storming columns for the purpose of clearing the way. In this work high explosives play a leading part. On the defensive the pioneers assist in the work of fortifying the ground, clearing the foreground of obstructions so as to permit of a clear field of fire, constructing obstacles, such as wire entanglements and mines, building or improving the communications in rear to permit of the ready movement of troops and artillery and erecting special structures, such as bomb-proofs, observing stations, dressing stations for wounded, etc. If villages or towns are to be defended, the pioneers loophole the walls, barricade streets, and provide direct communications inside the lines by breaching openings through walls and buildings.

During retreats the pioneers are charged with blowing up bridges, damaging railroads, destroying stores and practising similar operations designed to delay the movements of the enemy. As time is the all-important element high explosives constitute the principal reliance. The best military explosives are those which are of solid form and of shapes which will permit of their being rapidly and conveniently assembled into larger charges. Picric acid or trinitrotoluol in the form of blocks or cylinders are the most suitable explosives and the ones almost universally employed for military purposes.

Sapping During Sieges

In sieges the duties of the pioneers become of paramount importance. Here the trench work must be largely done by them by the slow and tedious method of sapping which consists in the excavation of the trench at its head in a manner similar to that of driving a tunnel. When the enemy's forts are reached, mine shafts and galleries must be driven under them and the works finally blown up. It is hardly necessary to state that this work is exceedingly dangerous under the concentrated fire of the enemy and his counter-moving operations and that the casualties of the pioneers will be heavy.

The foregoing reference to the duties of the engineer troops in campaigning by no means exhausts the list. It must be apparent that they have no easy task, for they must not only march and fight with the other troops, keeping abreast of them at all times, but must frequently execute laborious tasks for the benefit of their comrades, tasks which, though highly important, are less romantic and glorious than the charge and the hand-to-hand encounter.

The fundamentals of military engineering do not differ from those governing civil practice. There is, however, this difference—the results sought are as often destructive as they are constructive, and economy in a financial sense must yield to economy in time, which is the all-governing consideration in military operations. The military engineer is, however, handicapped in his operations by an absence of all the labor-saving and efficient machinery and the variety of adaptable material at the disposal of the civil engineer. He must, therefore, be all the more resourceful in turning to his purposes the scanty resources immediately at hand. One material he can always find in unlimited quantity and that is earth which, in fact, constitutes his principal building material supplemented by whatever timber, wire, stone that may happen to be handy. One thing in which the military engineer has an advantage over his brother in civil practice is that he need not worry over property rights. Under the stern law of military necessity he is free to help himself to anything which will answer his purpose and without fear of consequences.

The Field of the Slow Sand Filter

It is generally admitted that the field of the slow sand filter is narrowing while that of the rapid sand, or mechanical filter, is widening. Granting this we believe many readers will appreciate something definite to which to tie in choosing between the two types for a given locality. The choice will naturally rest in any case upon the comparative cost and efficiency of the two types. The question of cost is readily worked out by the designing engineer and the efficiency to be expected will depend upon the characteristics of the raw water to be filtered. Definite figures on the latter point were proposed as a guide by Mr. Robert Spurr Weston of Boston, in discussing the paper on "Present Day Water Filtration" read by George A. Johnson before the latest annual convention of the American Water Works Association. The following matter is quoted from Mr. Weston's discussion:

Each locality has its problem and should attempt its own peculiar solution. Undoubtedly, many slow filters were built and installed where rapid filters should have been chosen. Pittsburgh and Washington, D.C., are cases in point, and which have occurred in the writer's practice, but there are other cases where slow filters are not only more economical but more efficient than mechanical filters, and some of these cases are where high rates of filtration may be employed without detriment, because it is obvious that the cost of slow filters per million gallons decreases rapidly and inversely with the rate of filtration.

Generally speaking most engineers who are competent in the field of water purification, that is, those who have studied the problem for a long time in connection with many types of waters, are agreed that mechanical filters are best where the color is over 50 parts and the turbidity over 30 parts per million, or where there are unusual fluctuations in the character of a stream, which ordinarily is but slightly colored or turbid. Again, there are other cases where the water is so clear that there are no nuclei to start the coagulation of the applied chemical, upon which coagulation the efficiency of mechanical filters depends. To use mechanical filters in these cases may necessitate the addition of clay or other suspended matter to produce an artificial turbidity, or the use of an excessive amount of coagulant, so that the coagulant will precipitate by virtue of its large mass.

Before this paper was written the speaker made some studies of the comparative costs of slow sand and mechanical filters for presentation at a town meeting, and came to the conclusion that an average cost of $14,500 per 1,000,000 gals. for mechanical filters and a cost of $100,000 per acre for slow sand filters were good average figures. These figures are higher in the case of mechanical filters and lower in the case of slow sand filters than given by Mr. Johnson. In Mr. George W. Fuller's report on the Montreal Water Supply, dated July 22, 1910, the cost of sand filters was estimated at $33,840 and mechanical filters $21,091 per million imperial gallons daily capacity. The cost of slow sand filters per million gallons varies with the rate, as the following tabulation, assuming covered filters and appurtenances to cost $100,000 per acre, shows:

Rate of filtration mgd.	Cost of mgd.
10	$10,000
6	16,667
5	20,000
4	25,000
3	33,333
2.5	40,000

The cost of mechanical plants generally varies with the character of the water, and the writer believes the estimates in the following tabulation represents the best practice in plants of moderate size. The costs include the necessary subsiding and coagulating basins; also small filtered water basin or pump-well:

Character of water. Turbidity of color.		Cost per mgd.
0 — 100	or 0 — 25	$14,000
100 — 300	or 25 — 75	16,500
300 upwards	or 75 upwards	18,500

The above costs are higher than those of the largest and best plants constructed under favorable conditions, but lower than those of plants where unusual conditions prevail.

A mechanical and a slow sand filter, each of 1,000,000 gals. daily capacity, designed and constructed under the speaker's supervision during 1913, cost $16,000 for the mechanical and $18,000 for the slow sand plant. The cost of engineering for the mechanical filter was unusually high and the slow sand filter was in connection with a deferrization plant, where the costs included a coke trickler, 15 ft. high and 30 ft. in diameter, and where the filter operated at 10,000,000 gals. daily rate.

In the paper under discussion many references have been made to the hygienic efficiencies of plants treating waters which have been disinfected with chlorine, and in many cases these have been compared with waters which have not been so treated. The cost of sand filtration depends upon the rate. In the early days, as will be remembered, slow filters were designed at rates of 2,650,000 gals. per acre per diem, and less, this rate being the German official rate of 100 vertical millimeters per hour. If bleaching powder be used to sterilize the effluent, there is no reason why this rate cannot be raised much higher than 6,000,000 gals. per acre, which is the maximum in ordinary present day practice.

Apart from the cost and efficiency factors in some cases, the speaker is in hearty agreement with the conclusions of Mr. Johnson's paper, namely, that the mechanical filter is an efficient and reliable sanitary machine, one that will reduce the death rate due to water-borne diseases. It is true that the zone in which slow filters are used is narrowing, while that in which mechanical filters are used is broadening, but the speaker still contends that there is still a field for the slow filter, namely, where clear waters have to be purified and where local conditions make the cost of water furnished by the slow filter less. In comparing the efficiency and economy of the two types, one should use the same basis. One should not compare the efficiency of filters where the effluent is sterilized with those where no sterilizing chemicals are used.—Engineering and Contracting.

English Specifications for a Bituminous Concrete Mixing Plant and Details of the Acceptance Test

An abstract of the specifications used in purchasing a plant for preparing bituminous concrete and a description of the acceptance test used is given by W. H. Grieves in a report to the Urban District Council of Surrey (England) published in the London Surveyor. The adaptability of the plant to work in hand is also discussed.

Plant Required

The following is a short specification of the plant for bituminous material:

One Coleman's patent stone and sand drier, consisting of one 5 to 6 h.p. gasoline engine, with water tank and fittings complete; one drier and furnace capable of drying and heating to a temperature of at least 400 degrees F.; stone, slag, sand, clippings, or any other similar material for bituminous road making, and including all pulleys and fittings and elevator. The whole mounted on a steel frame, lock, steel wheels and axles of sufficient strength to carry the required load. The machine to be fitted with brake and draw-bar.

The total output of bituminous compound of the above machine is guaranteed to be approximately 40 to 60 tons per day, according to weather conditions.

One Coleman's mixer, mounted on steel frame, forecarriage and lock with steel wheels and axles, the mixer elevated to a sufficient height to allow the material to empty into a cart.

One enclosed elevator for lifting the material into measuring bin, with the necessary raised platform for men to work upon.

One 10 h.p. gasoline engine, with water tank and fittings.

One small hand winch and wire rope for elevating bitumen.

One measuring bin of 1,000 to 1,500 lbs.

Brake fitted, and mixer supplied complete with draw-bar. The above machine is capable of thoroughly mixing the material with the bitumen at the rate of about 1,500 lbs. in three to four minutes.

The total cost of the machinery would probably be about $4,500.

The main idea is that the sand should not only be absolutely dry, but it must be heated to a temperature not exceeding 180 degrees C.

Work to be Accomplished

Assuming that the machine could be worked 150 days in the year at 40 tons per day, it would turn out 6,000 tons per annum. Allowing for 1 foreman, 2 men feeding the machine, 2 mixing, 1 man at the bitumen tank, 1 engine driver, 2 men wheeling, 3 men laying the material, the cost of sand, bitumen and filler, and adding charges for maintenance, haulage, depreciation, depot rents and steam rolling, the cost per ton would equal about 50 to 60 cents per square yard.

The cost of the main roads already repaired amounted to over $30,000. There still remains to be repaired, on the main roads, an area of 24,870 sq. yds., which, at $1.20 per square yard, would cost $29,844. Putting the cost of the new method at the higher figure of 60 cents per square yard, this would amount to $14,922, effecting a saving of about $15,000, or more than enough to pay the cost of the machinery three times over. The machinery could also be used for mixing tar or asphalt macadam, and for this purpose stone taken up from other roads could be used in addition to new stone.

The following test of the machinery was made at the manufacturers' works in the presence of a subcommittee appointed by the council for the purpose:

Wet sand was put into a measure 3 ft. 6 in. square by 9 in. deep, and then put into the drier, and immediately came out of the drier at a temperature of 360 degrees F. Within 5½ minutes 750 lbs. were put through the machine, and came out at a temperature of 600 degrees F.

A second lot was put in, to which 4 gals. of water was added to the already wet sand, and within 1½ minutes this was turned out of the machine at a temperature of 500 degrees F. The temperature of the wet sand before it was put in was 70 degrees F. One man fed the mixer with 750 lbs. in seven minutes. Ordinary sand on a dry day was then put in, and the 750 lbs. was passed through the machine in 3½ minutes at a rising temperature of over 400 degrees F. In the combined stone and sand drier 2 tops of wet limestone macadam were put through the machine, and after remaining in the same for ten minutes, came out at 470 degrees F.; 2,100 to 2,200 lbs. of sand were passed through this machine in 8¼ minutes, and came out at a temperature of 465 degrees F.

This mixer will discharge 1,000 to 1,500 lbs. in three minutes.

Stone revolves in this machine at the rate of 14 miles per hour, and sand at the rate of 25 miles per hour.

Bricklaying Costs for 5 to 10-Ft. Brick Sewers at St. Louis, Mo.[*]

An attempt to standardize bricklaying methods in sewer construction so as to secure the greatest efficiency at each step of the work was recently made in St. Louis. The contract on which this attempt was made was for the third section of the Glaise Creek Joint Sewer, which was carried out by the American Contracting Company. This contract consisted of 7,370 ft. of brick sewer, varying from 5 to 10 ft. in diameter and from 13 to 18 in. in thickness. The total amount of brickwork was 10,264 cu. yd., consisting of 9,600 cu. yd. common and 664 cu. yd. of vitrified brick masonry (to line the invert for the dry-weather flow).

It was found that by planning the work so that a certain number of bricklayers could be constantly employed, the best men could be kept. The importance of this feature is nearly always underestimated by contractors. The difference between the work done by a good man and an average man is at least 10 per cent., and where full time can be made the very best men are obtainable.

The next step was to get the maximum of work from the bricklayers. This meant not harder work, but eliminating lost motion: The essentials were proper working room, sufficient materials in the right place, and safe working conditions. Solving each of these problems required much experiment. Too many or too few bricklayers in a given space was found to be equally expensive. Materials in the right quantity, just when needed, make it unnecessary for a $9-a-day bricklayer to wait for a $2.50 laborer.

The principle of "safety first" was found to be of more importance than merely a humanitarian measure. Accidents demoralize efficient work, and a little extra care and expense along this line will more than pay for itself. For example, brick baskets were used instead of slings, and only material immediately to be used was allowed on scaffolding.

The elimination of useless labor was one of the greatest problems. Mortar was mixed by machinery at a cost of less than 1c per cu. yd. for power. Great care was taken to have this mortar of just the proper consistency. It was found that, everything else being equal, the day's work could be increased 2 or 3 per cent. by having the mortar exactly right all the time. The mortar was dumped directly from the machine into barrows and then poured into chutes. Thus the bottom man had only to direct the mortar into the boxes below. Mortar mixers and mortar lowerers were stored as close to the ditch as possible and in the same quantity as would be used in that length of sewer.

The job was started November 4, 1913, and finished August 18, 1914.

The cost data are based on the following prices for labor and material delivered:

Bricklayer	$1.12½	per hr.
Labor	0.31	per hr.
Brick common	8.50	per M.
Brick vitrified	16.50	per M.
Cement	1.40	per bbl.
Sand	0.85	per cu.yd.
Electricity	0.10	per kw.hr.

The constants for each cubic yard of brick were:—

430 common brick at	$8.50	$3.66
338 vitrified brick at	16.50	5.58
0.65 bbl. cement at	1.40	0.91
0.35 cu. yd. mortar at	0.85	0.30
0.10 kw.hr. at	0.10	0.01

The mortar was 1 part cement to 3 parts sand.

This makes the material cost $4.88 per cu. yd. for common and $6.80 per cu. yd. for vitrified-brick masonry.

The monthly records were as follows:

		Cubic yards laid			Cost per cu. yd.		
Month		Common	Vitrified	Per day of 8 hr. per bricklayer	Labor	Total common	Total vitrified
Nov.,	1913	768	53	9.3	$2.25	$7.13	$9.05
Dec.,	1913	1444	99	10.8	2.02	6.90	8.82
Jan.,	1914	1260	87	11.7	1.90	6.78	8.70
Feb.,	1914	60	4	12.0	3.00	7.88	9.80
Mar.,	1914	416	29	10.5	1.90	6.78	8.70
Apr.,	1914	1132	78	11.8	1.78	6.66	8.58
May,	1914	970	68	11.0	2.24	7.12	9.04
June,	1914	1019	70	9.9	2.26	7.14	9.06
July,	1914	1912	133	12.6	1.77	6.65	8.57
Aug.,	1914	619	43	8.5	2.65	7.53	9.45
		9600	664				

Average cu. yd. per bricklayer per day of 8 hr.		$11.05
Average labor cost per cu. yd.		2.02
Average cost of brickwork per cu. yd.	common	6.90
	vitrified	8.82

The high cost of labor in May is due to tunnel work at night, when double time was paid to bricklayers. The high cost for June is due to bad working conditions, where frequent cave-ins caused much delay. The last month's figures are not significant, as the best men had left for other jobs and lots of cleaning up was necessary.

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[*] By C. L. French, St. Louis, Mo., in the Engineering Record.

Comparative Costs of Three Types of Foundation Construction

THE Boston & Maine R. R. has recently completed the construction of a very large group of shop buildings at Billerica, Mass., comprising in all 10 large structures. This is one of the largest railroad shops in New England.

The soil conditions on the site of this work consisted of a surface soil of sand and peat underlaid by a water-bearing sand. When the engineers were considering the design of foundations for these buildings they investigated three types of construction, viz.:

1. Concrete piers carried down in open caissons to firm strata.
2. Wooden piles cut off at ground water level and capped with concrete piers.
3. Concrete piles driven from the surface of the ground and capped there.

A comparative estimate of cost of the above three types of construction showed a very large saving in favor of concrete piles, and this type of construction was actually used.

COMPARATIVE COSTS

Concrete Pier

Excavation, pumping and backfill	$ 90.00
Sheeting and bracing	100.00
Concrete, 18.5 cu. yds. at $7.50	138.75
Total cost	$328.75

Wooden Pile Pier

Excavation, pumping and backfill	$ 40.00
Sheeting and bracing	60.00
Concrete, 17.5 cu. yds. at $7.50	131.25
16 wooden piles at $5.00	80.00
Total cost	$311.25

Concrete Pile Pier

Reinforced concrete cap (including excavation), 6 2-3 cu. yds. at $9.00	$ 60.00
8 concrete pedestal piles at $15.00	120.00
Total cost	$180.00

The design for a typical pier in this work based on the three above mentioned types of construction is given in Fig. 1, and the accompanying table gives the estimated cost for the foundations of this typical column for the three types considered. These comparative designs and estimates show the method by which in any particular case investigation may be made to determine which is the most economical type of foundation to use.

Contract for the foundation, including piles and capping, was let to the MacArthur Concrete Pile & Foundation Company. About 3,000 pedestal concrete piles were driven, together with a large amount of reinforced concrete capping.—Concrete Cement Age.

The Cedar River dam at the water supply for the city of Seattle, Wash., was finished November 2, and two days later the rock tunnel was completed. The expenditure for the work has been $1,470,000. The storage basin has a capacity of 5,200,000,000 cu. ft. Preliminary work was started July 1, 1910, and the work was under the direction of the city engineering department up to July 1, 1913, when a contract for completion was awarded to the Nettleton-Bruce-Eschbach Company for about $700,000. The height of the dam is 160 ft. above the bed of the Cedar River and its length at the crest is about 1,000 ft.

In a Belgian publication, Union des Ingenieurs de Louvain, the possibilities of cement in a new field are brought out. Who would have ever thought that there would be anything in common between the automobile industry and that of concrete masonry construction? Yet the supposition is not so strange and is verified in the statement of a recent experiment that has been made by one of the leading carriage concerns in Paris which is building its automobile bodies out of a plastic amalgam of concrete and cork poured around a metallic trestle stretched between wooden frames corresponding to the architectural lines of an automobile body. When completed this body does not differ from those in ordinary use, but this method of manufacture permits the lines to be better established, the angles to be rounded and makes practical a body much lighter than does the ordinary wood and steel construction.

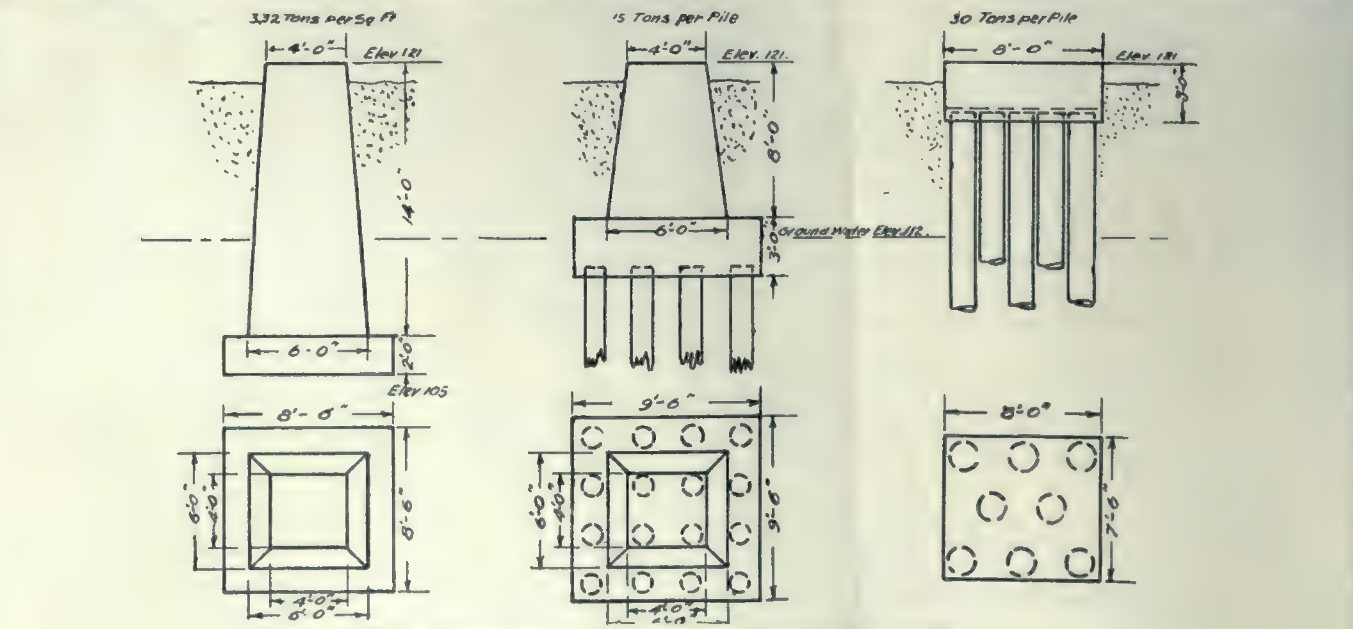

Fig. 1—Comparative design for three types of foundation construction.

The Value of System in Contract Work*

Details of Organization Which Make for Success—Advantage of Timing Construction—Suggested Form of Sub-Contracts

HOW does a successful contractor plan his work—by days—by weeks—by jobs? To tell that, in detail, is itself a pretty big contract, and isn't the easiest thing in the world to do; but I have handled a few big contracts in my time, and this may not be too difficult.

I am the senior member of a more or less successful contracting firm in a certain good-sized city on the Ohio River; and while we haven't got everything figured down to the finest possible point, yet there are a number of things which might be said to constitute our system, our plan, of doing business, and which we never deviate from.

To begin with, the work is divided between my partner and myself, according to that which we can do best. He is possibly the better superintendent, and he therefore attends to all the outside work, making the round of all jobs which we have under construction, seeing that material is on the ground and the like—all the numerous details that come up and have to be seen to, in spite of the fact that we have a capable superintendent. I handle the office, making up estimates, attend to the payment of bills, the correspondence, and all that sort of thing. And we are both kept busy enough, too. I don't mean that I never oversee any of the work, nor that he never makes a contract or helps figure and estimate on a job; but I do mean that we make it a point not to be on the same job, at the same time—that's where the system comes in.

We figure that one of us can do a thing, in most cases, just about as well as both of us together could do it, and that it would therefore be poor business to waste the time of one of us helping the other to do a thing which he could do alone. The only exception to this is one hour of the day—the noon hour. We make a rule to lunch together whenever it is practicable, because we have found it a good idea to get together at that time, when things are somewhat relaxed, and have a talk while we eat. It's a good time to untangle little matters that have come up, and then each can get any advice he wants of the other. It is a sort of council of war, where plans can be laid and courses of action decided upon, whenever necessary; and we both go back to work feeling that we are not alone—that we have a good man behind us!

Then, we always save some time that others waste, not to mention incidental damage to materials, by not being in too much of a hurry to start on a job. That may sound somewhat peculiar, but it is the exact idea I wan to convey. Very frequently, in fact, nearly all the time, as soon as the plans and specifications are complete and the contract is made, the owner is in a wild rush for the work to begin. He sees no reason for an instant's delay, and is utterly unable to understand why the fool contractor stands around with his hands in his pockets and waits for days and possibly weeks, before beginning the job.

The point is, of course, that we are not standing around with our hands in our pockets, by any means. Why begin excavation on a medium-sized or small building in such a time that it will be finished long before your foundation material could be on hand, and be caving and possibly filling with water in the meantime? Or, what is more usual, why complete your foundation, and have your basement open to the weather, before you have completed arrangements for the delivery of frames, so that the job can go right on up? The same thing applies where there is any particular kind of brick to be used, especially, of course, if it is in the nature of a special order. And mill work should be ready at the time when it is needed, in order to prevent delay in the work, having men on your hands idle half of their time. That sort of thing eats into profits, and is entirely useless. A little foresight is all that is necessary. The delivery of every scrap of material can be arranged for in advance, to be on the ground just when it is necessary, according to a definite program; and yet I have seen builders who neglected this first essential to a successful job.

Where the material required is such that it has to be ordered specially, and always where it must come from out of the city, I take particular pains to see that there will be no hitch in delivery—that is, none that will leave me without legal recourse. If it is a small quantity, I usually order it at once, and have it delivered, as the certainty of having it on hand makes the immediate investment worth while. If it is a large quantity, however, I make a formal contract, and have a penalty clause just like that which is contained in our contract with the owner, so that if the factory, or quarry, or whatever it is, falls down on its contract, we are protected.

It goes without saying that we have at hand on each job complete detailed plans and specifications, ready for reference all the time. In addition to these, however, we also have a complete set of the sub-contracts made, so that the superintendent and foreman on the job can at once ascertain what sub-contractor is responsible for any part of the work or material, at any time the information becomes necessary.

A Suggested Form

Our sub-contracts, by the way, are made up on a form which we have devised, which we think is pretty good. On one side we have a short proposal blank, running about this way, with date-line and address:

Gentlemen:

We propose to furnish all materials and labor and do the .... for....the..............job, or building, located on ....street, between .... and .... streets, being No..... in the City of .... County of .... and State of .... said work and materials to be in accordance with the plans and specifications as prepared by ...., Architect, and in order that there may be no misunderstanding, we will further state (here is a blank space for such further remarks as may be deemed necessary). For the sum of .... Dollars.

We agree, upon written notice from you, to start the work within .... days after receipt of said notice, and push said work to completion as rapidly as possible.

The blank has space for the sub-contractor's signature and an acceptance line for us. On the other side of this form are eight ruled spaces, all just alike, under the following printed lines:

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* By G. Crain, Jr., in The National Builder.

"Received of (our firm) partial payments on account of work and material as per contract on the reverse side as follows:"

And in each space is room for the date, signature of the firm, and the amount of the partial payment. At the bottom is a slip, which can be detached by a perforation, in which to sign a receipt and release in full, when all payments are made. The detailed statement of partial payments is filed alphabetically under the name of the sub-contractor, with all other matter relating to his contract, and the slip is turned over to the owner, or placed in his file, as evidence that the property is clear of liens on the part of sub-contractors.

It might be mentioned here that there is but one check-book out of which drafts are made on the firm account, and that is kept in the office. Our pay-roll, of course, is handled by one check, and the men get their money in cash, in the usual pay-envelope. I have known contracting firms, though, who never knew where they stood on a job, because two or three members were issuing checks here and there, and it was simply impossible to keep any track of them.

We have a bookkeeping system which enables us to know to a cent what a job has cost us, and that is considerably more than some men know; and yet it is absolutely necessary, in order for the contractor to find out what his profit—or loss—is, as the case may be. We have three ledgers, in one of which is recorded all that we buy, with the credits to us by return of material and cash payments; in another, the materials put into the job, and payments made to sub-contractors for work and material; and in the third, our accounts with the owners. There are appropriate accounts in the first two ledgers for every head under which expenditures on a building may fall, and not a cent is spent for even carfare that is not properly charged. When we get through a job we know just what we have spent, and we know just what we have spent it for; we know what we have received in payment for the work. And from these facts, it isn't hard to discover just how we stand on the job.

Securing Good Work from Men

"HOW do you make men work?" a prominent contractor was asked recently. "I don't make them work," he replied—and that is probably the reason of his success with men—they work of their own accord, work because they respect him and because they like his treatment of them, his sympathetic though firm leadership, his loyalty and fairness. There are all kinds of men and all kinds of results to be obtained from employing them. Some are profitable for their employers, others are not. Many are willing to work and some willing to shirk and the difference betweeen working and shirking is frequently the difference between profit and loss for the employer, says a writer in Building Progress.

All employers are concerned about the same proposition—how to make profit out of men. Many in business for years have not discovered the way to make labor pay, though other employers have solved the problem comparatively easily. Why does one firm get good work out of its men when another firm is always up against it when it comes to labor? Why is it that one employer has no labor troubles and another is in hot water all the time though apparently both treat men equally well? The first requisite for loyal labor is being loyal to yourself. No man who hires another can expect to get any better treatment than he gives, and if he shows a disposition to treat his men any less than well he may reasonably expect poor work from them. Almost every builder has at one time or another been a hired man and he need take but a few moments of reflection to recall the jobs he held which were of most profit to himself and his employer. Any builder who can call back to his mind some of the early jobs before his own shingle was hung out will remember that he did the best work for that employer who treated him with most fairness, and this work, you may be sure, was profitable for employer and employed.

Contrary to the opinion of many, labor is practically an exact science. Wages are fixed in advance and every builder of experience knows about how much work he may expect as the result of each day's labor. In checking labor items this is the first computation to make—how much is a fair day's work? After having done this, contractors should expect good, average efficiency from every one in their employ, well up to the standard day's work they know men are capable of, under right conditions. Mechanics who drop below this efficiency will bear watching and a builder should keep tab on his men to the extent that he may know whether they are keeping up to the mark or not. Many contractors, recognizing the necessity of examining into the efficiency of their men, keep a card index record of each, marking every man a certain percentage at the end of every week's work.

There are various ways to keep men up to their right degree of efficiency. Many builders have found it pays to watch carefully to see that no workers are taking unnecessary steps or using false motions in executing work. One builder discovered that the lengthening of a gangway, making it one plank longer, produced 30 wheelbarrows of concrete a day more than formerly, as the gangway was made less steep and men could heap the barrows, carrying more at greater speed. Workmen had made this gangway themselves, but with poor judgment. When the change was made they were themselves pleased, as it took less effort to climb up. Mixing concrete by machinery is now known to be the best way to get the largest amount of material properly mixed, and the installation of a concrete mixer has put dollars into many a builder's pockets besides earning him the gratitude of his men. Even after a mixer is installed one builder will produce his concrete at less cost per yard than a competitor, because he scientifically arranges a scaffolding so that loading and unloading is as automatic as possible. One machine properly arranged will eat up a constant string of wheelbarrowfuls of material, and it has been found in most localities that hand mixing is no longer profitable, however cheap labor may be.

The foreman is the key to many a builder's bank account, though frequently builders do not realize it. An efficient, loyal foreman is the most important acquisition to any contractor's staff, and when a foreman is secured who is really a winner the contractor had better love him like a brother. Probably more wrecks in the contracting business are caused by inefficient foremen than from any other cause. Your foreman can be so firm so long as he is fair and yet be popular with men. In truth, workmen are inclined to respect firmness wherever found, firmness tempered with justice. It seems to be a characteristic of human nature everywhere to admire a real leader, and that is what your formen should be, a leader—a captain who gets the utmost efficiency out of the squad under his command, gets it by executive ability and tact.—Building Progress.

The Hennebique System of Ferro-Concrete Construction

A Description of Noteworthy Buildings Erected at the Coast, Prefaced by a Sketch of the Origin and Growth of the Pioneers of This System, Messrs. L. G. Mouchel & Partners

SOME seventeen years ago, the late Louis Gustave Mouchel, a former French Government Engineer who had settled in South Wales, undertook the introduction of the Hennebique System of Ferro-concrete into Great Britain and established the civil engineering practice which has been continued to the present day by his successors, Messrs. L. G. Mouchel & Partners.

In the early days of his enterprise, ferro-concrete was practically unknown in the United Kingdom and Mr. Mouchel had to encounter serious opposition, but this has long since been swept aside by the advantages attendant in the employment of ferro-concrete construction.

Among the first important works executed from the designs of Mr. Mouchel were Harbor Works at Southampton, granary and flour mills at Swansea, jetties and warehouses at Liverpool, and railway warehouses in London and elsewhere. During the first five years of his career as a ferro-concrete engineer, Mr. Mouchel secured commissions for the design and erection of some fifty structures, many of considerable magnitude, and the confidence engendered by these speedily led to the far wider use of the new structural material—a point clearly illustrated by the average record of about fifty Hennebique works a year during the three succeeding years, and the fact that over two hundred structures of the kind had been completed by the end of 1905.

An acknowledgement of ferro-concrete—and of its pioneer—was furnished in 1906 by Mr. Mouchel's appointment by His Majesty's Office of Works as their consulting engineer to be responsible for the structural work in the new General Post Office, London, comprising two huge blocks of buildings built entirely in accordance with the Hennebique system.

The total number of ferro-concrete structures completed by the end of 1909 amounted to some eight hundred. These included wharves, jetties, quays, highway and railway bridges, water reservoirs, sewage tanks and grain silos, as well as Government, dock, railway, municipal, industrial, commercial and residential buildings of every description.

Some time before the death of Mr. Mouchel, in 1908, his practice was transferred to a limited company and continued under the style of L. G. Mouchel & Partners, the present chiefs being Mr. J. S. E. de Vesian, M. Inst. C. E., M. I. Mech. E., and Mr. T. J. Gueritte, B.Sc., M. Soc. C. E. (France), two engineers who for a long time had been associated with Mr. Mouchel and Mr. Hennebique in the design and superintendence of many important ferro-concrete works in all parts of the country.

The present firm, in introducing the Hennibique

Belmont Building, Victoria, B.C. Mr. Hoult Horton, architect.

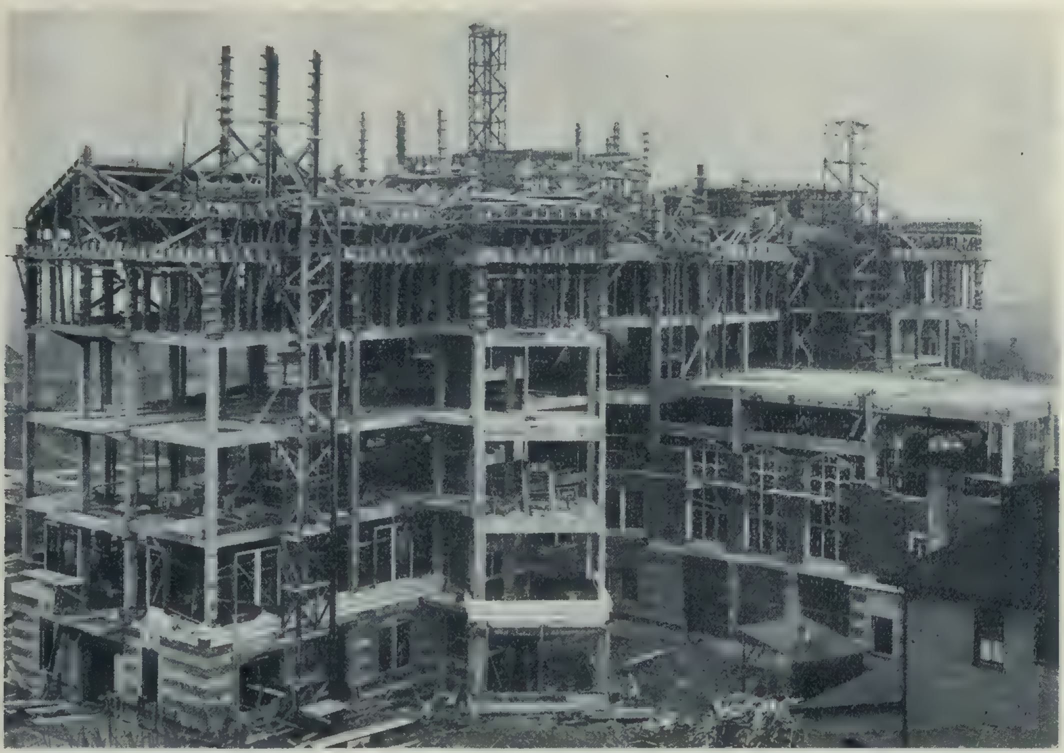
Birks Building, Vancouver, B.C. Messrs. Somervell & Putnam, architects.

system of construction in the United Kingdom and Canada, have adhered to the methods which contributed in great measure to the stability and permanence of Hennebique structures all over the world. Briefly stated, in the United Kingdom these methods comprise the maintenance of a technical organization with head offices in Westminster, and branch offices under the charge of qualified engineers in different parts of England, Wales, Scotland and Ireland, and the appointment of experienced contractors of the highest standing, by whom all works are executed and who are directly responsible to clients as well as to the firm for the satisfactory performance of their duties. Thus the staff in the chief technical office is able to concentrate its attention on the design of structures to be carried out, the various district engineers being engaged in the important work of superintending practical operations from the beginning to the end of each contract.

The year 1910 was noteworthy in the annals of the firm in two respects—one for the record number of over two hundred commissions for Hennebique works, and the other for the appointment of Mr. de Vesian as the engineer responsible for the design of the new bridge over the River Suir, at Waterford, Ireland. This appointment, made by His Majesty's Privy Council in Ireland, and confirmed by the Lord-Lieutenant, was followed by the construction of the magnificent ferro-concrete structure, 700 ft. long by 48 ft. wide, taking the place of the old timber bridge formerly providing the only highway communication between Waterford City and Waterford North. In 1911 the Portuguese Government appointed the firm consulting engineers for reinforced concrete works to their Colonial Office, and later they were appointed by the British Crown Agents for the Colonies in similar capacity.

An idea of the extent of the firm's operations is conveyed by the fact that at the end of 1912 nearly two thousand works had been completed on the Hennebique system in the British Isles alone, whereas the total number of Hennebique structures completed to that date amounted approximately to 27,000. These works include engineering and architectural works of

St. Paul's Hospital, Vancouver, B.C. Mr. Robert F. Tegen, architect.



St. Paul's Hospital, Vancouver, B.C., under construction.

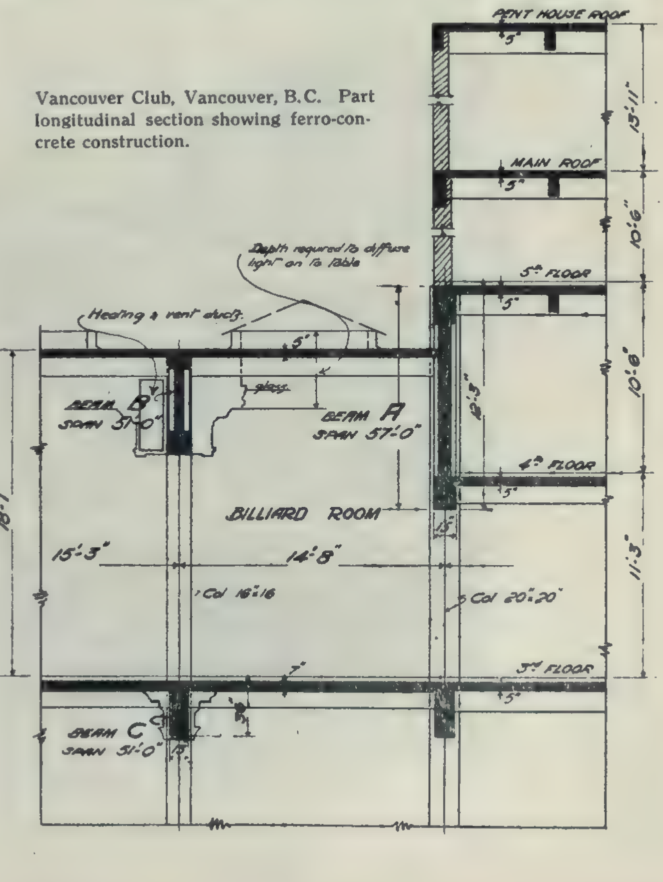
the most varied description and, in numerous instances, of unparalleled magnitude. Among them are found some of the finest examples of ferro-concrete construction of the present day.

It is interesting to note that the total number of bridges built to the end of 1912 was 1,744, as detailed in our last issue. In this number is included the Risorgimento Bridge over the River Tiber at Rome. This structure is 328 feet span and the longest span ferro-concrete bridge in the world. Another bridge worthy of note is a bridge at San Sebastian in Spain. This bridge is finished in black and white marble concrete, polished by hand, the design being of a highly ornamental nature.

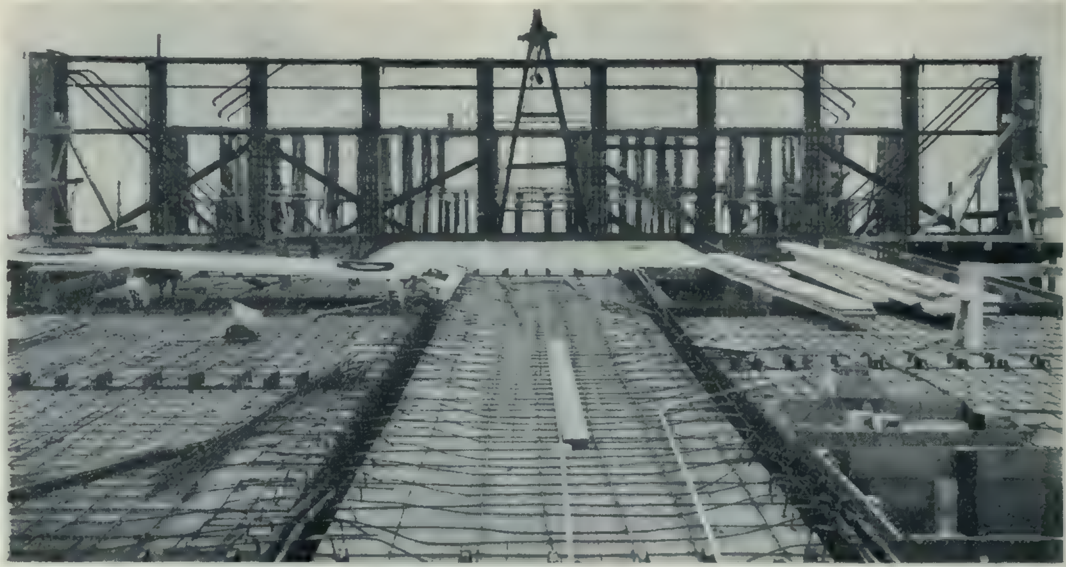
Among the works executed in the United Kingdom in addition to the new General Post Office, London, to which reference has already been made, we may mention extensions of the Manchester and Glasgow General Post Offices. Other Government buildings completed recently are the new premises of His Majesty's Stationery Office, and the new offices of the Board of Agriculture. The Royal Liver Building, forming a bold landmark on the shore of the Mersey at Liverpool affords striking evidence of the adaptability of ferro-concrete to buildings of the most monumental character, while the Manchester Dock Warehouses, nearly half a mile long, and the large grain silos, with the capacity of 1,680,000 bushels, now under construction for the Manchester Ship Canal Company, testify to the utility of ferro-concrete in commercial undertakings.

The wharves and jetties included in the project for the new Port of London Improvements have been placed in the hands of Messrs. L. G. Mouchel & Partners and have been designed in Hennibique ferro-concrete; also the firm have recently been appointed by the Dover Corporation as consulting engineers for the line of ferro-concrete viaducts and bridges extending right through the town, in connection with the improvement scheme formulated for the purpose of affording direct access to the harbour and new passenger station about to be built on the widened Admiralty Pier.

The Vancouver office of this firm has been responsible for a considerable amount of interesting building



Vancouver Club, Vancouver, B.C. Part longitudinal section showing ferro-concrete construction.



Vancouver Club. Reinforcement in place for ferro-concrete beam, 57 ft. span.

and engineering work. A few of the more important building features are described and illustrated herewith.

Belmont Building, Victoria, B.C.

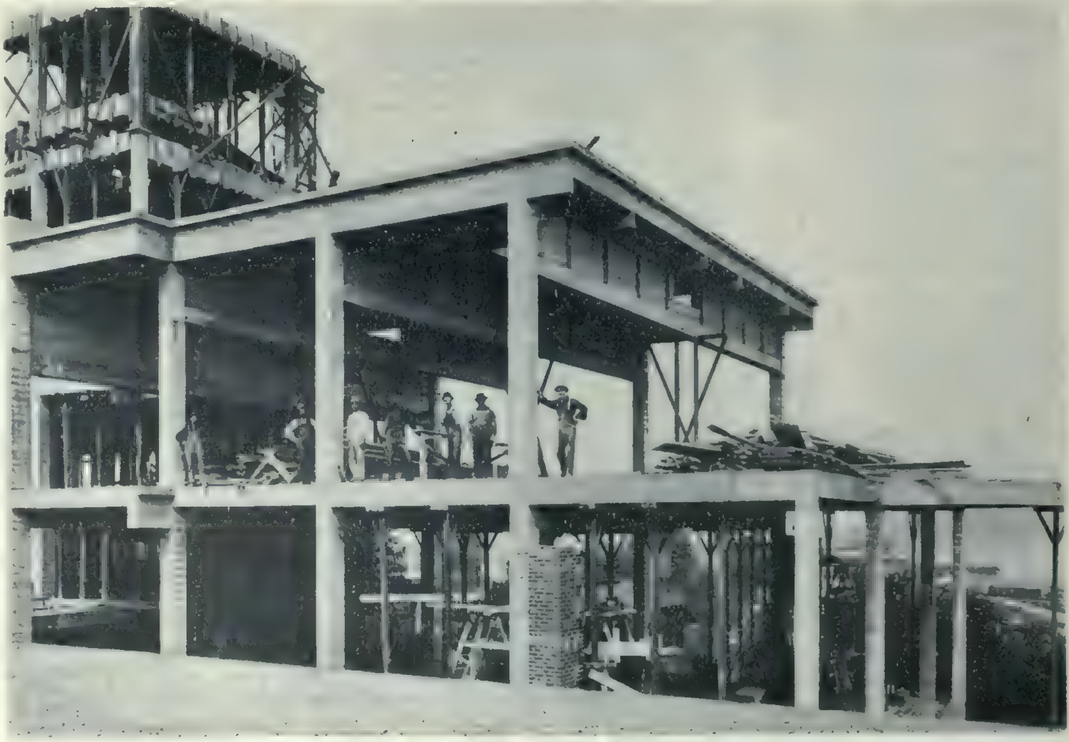
This building is the largest and best appointed office building in Victoria. It occupies a prominent position opposite the C. P. R. Empress Hotel, overlooking the inner harbour, bounded by Government, Gordon and Humboldt Streets.

The building is approximately 100 ft. by 136 ft. in dimensions, and has eight floors and a basement. The exterior facing is of buff terra cotta. Mr. Hoult Horton, of Victoria, was the architect.

St. Paul's Hospital, Vancouver, B.C.

The main building is 205 ft. by 45 ft., with central front wing of 52 ft. by 40 ft. There is a Chapel wing at rear and also two small lavatory wings. Connected to the main building by a ferro-concrete tunnel is a power-house and laundry.

This building was originally designed in steel, for which Hennebique ferro-concrete construction was substituted with considerable saving in cost. The complicated architectural features were not in any way affected or altered. The ferro-concrete structure accommodates the intricate terra-cotta work, heating and ventilation ducts, etc., without trouble, and the columns



Vancouver Club. Completed Ferro-concrete beams, 51 ft. span, in dining and billiard rooms.

occupy no more internal space than the steel encased in concrete. The roofs are entirely of ferro-concrete covered with metal tile.

Plate No. 3 shows the front of the completed building. The frame building on the left is the old hospital building which will be pulled down shortly. Plate No. 4 shows the ferro-concrete structure nearly completed. The architect was Mr. Robert F. Tegen, of Vancouver.

Birks Building, Vancouver, B.C.

This building is located at the corner of Granville and Georgia Streets, opposite the Vancouver Hotel. The site measures 100 ft. by 120 ft., and the building is comprised of ten storeys and a basement. The basement, ground and first floors are occupied by Messrs. Henry Birks & Sons, jewellers, and the remainder of the building is devoted to office accommodation. The chief point about the structural work is that after the structure was completed to the ground floor, the remaining nine floors and roof were completed in ten weeks. This, we believe, constitutes a record for Canada. The architects were Messrs. Somervell & Putnam, Vancouver.

The Vancouver Club

The Vancouver Club building occupies a site 184 ft. by 77 ft., and is located on Hastings Street, overlooking Burrard Inlet. The building is faced externally with terra cotta and light brown pressed brick. It is of the modern Renaissance style on the exterior and the same feeling is carried out in the interior.

The structure of five floors and basement provides accommodation for large dining room, ladies' lunch and tea rooms, billiard room (six tables), large lobby lounge, two visitors' rooms, card rooms, magazine and writing rooms, and twenty-eight bedrooms.

The nature of the site presented a difficult architectural problem to provide the large rooms unobstructed by columns, and to provide sufficient daylight to all parts of the building. This has demanded a building which, structurally, is one of the most complicated in Canada.

The solution of this problem by the architects, Messrs. Sharp & Thompson, of Vancouver, has been a very happy one, and the Vancouver Club building is regarded as one of the finest of its kind.

The structural work was originally designed in steel, encased in concrete, with reinforced concrete floor slabs. An alternative scheme in Hennebique ferro-concrete construction was prepared and accepted. This construction not only afforded a great saving in first cost, but on account of the adaptability of Hennebique construction to architectural features, great advantage was offered on this score.

The ferro-concrete columns shaped to come within the walls, etc., occupied much less internal space than the steel columns encased in concrete. The big panel beams in ferro-concrete shown in the construction merely take the place of walls in the building and are unnoticeable. They compare very well in efficiency with big steel box girders weighing many tons, which are very difficult to accommodate architecturally and are very costly. In Plate No. 5 there is shown a longitudinal section of part of the building to illustrate this point. The beam A is 57 ft. span, 12 ft. 3 ins. deep over all, and 15 ins. in width. The reinforcement of this beam is shown in Plate No. 6, and Plate No. 7 shows the completed ferro-concrete work.

The beams B and C are 51 ft. span and C is 36 ins. over all and 13 ins. wide. One beam C was tested as follows:—

One whole bay 51 ft. by 36 ins. was loaded to 100 lbs. per square foot, the superload to which it was designed being 80 lbs. per square foot. The deflection registered at this load was 17-64th of an inch = 1/2190 of the span. The test load of 100 lbs. per square foot was limited as no more material was available. About seventy-five tons of material were used in this test.

The structural work of the above buildings has been carried out entirely in Hennebique Ferro-Concrete to the designs and supervision of the Vancouver Office.

It may be of interest to state that Messrs. Mouchel & Partners are arranging to extend their activities in the Dominion. With this end in view they have opened a Toronto office (Mail Building) in charge of Mr. F. G. Engholm, A.M.Inst.C.E., A.M.Inst.M.E., their representative for Canada.

The firm's Head Office in the Mother Country is at 38 Victoria Street, Westminster, London. Their Vancouver office has been established some few years.

Wrecking Concrete Buildings

A FEW years ago no one gave much thought to such matters as the wrecking of reinforced concrete buildings to make room for new structures. At that time, concrete buildings were deemed permanent, and it was taken for granted that very few concrete buildings would ever have to be torn down. Progress in building has shown that concrete structures will in the future have to be wrecked to make way for modern structures. For this reason the following methods of wrecking two different concrete buildings, given by Cement World, will be of special interest:

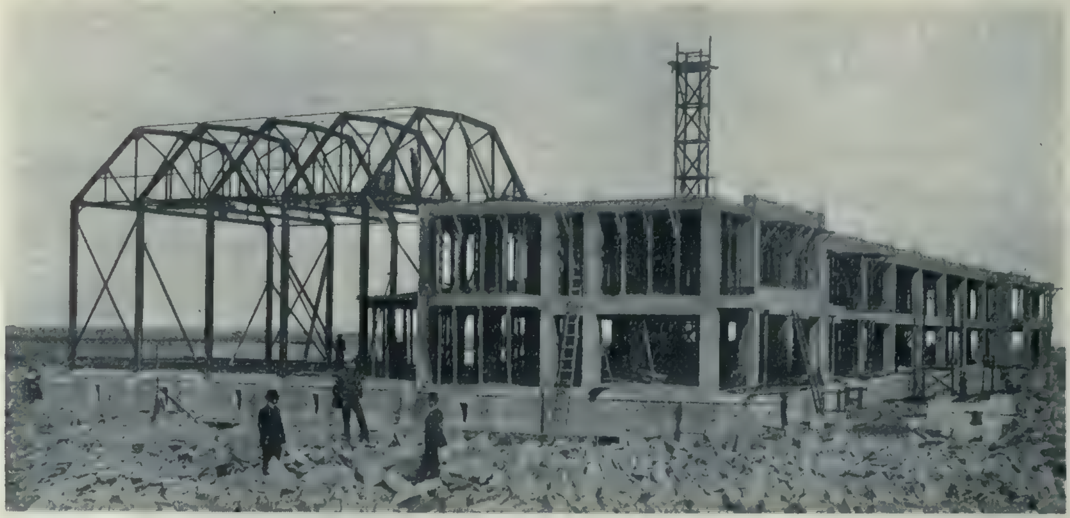
Wrecking with Dynamite

In wrecking a one-storey reinforced concrete building of the beam-and-girder type in Baltimore, recently, small charges of dynamite were used at the top and bottom of all columns, to sever them from the girders. The girders torn loose by the charge of dynamite, dropped to the ground and were readily broken up. The floor-slabs were broken up by means of heavy sledges before destroying the girder connections with columns. The dynamite severed the column connections; and, after dropping to the ground, they were broken up with sledges. The cost of wrecking this structure amounted to about $4.000 per cubic yard of concrete contained therein.

Wrecking by Oxy-Acetylene Torch

While building the new "Soo Line" freight depot in Chicago, it was necessary to wreck a four-storey and basement building used as a brass foundry by the Crane Company, to make room for the mammoth concrete structure upon which the freight yards and depots were placed. The building was of steel frame encased in concrete, with reinforced slabs between beams.

The oxy-acetylene torch was used to cut all structural and reinforcing steel; and, while so doing, it was discovered that the flame would cut concrete readily. For cutting concrete, it was found that acetylene and oxygen pressures of 20 and 50 lbs. per sq. in., respectively, produced the best results. Holes 2¾ in. in diameter were cut through an 8-in. concrete slab and two ¾-in. bars in 2¼ minutes These holes were cut in the centre of panels, to give a starting point for the men working with heavy sledges who broke up the entire slab. The I-beams encased in concrete and supporting the floor-slabs were cut in 12 minutes. Under the action of the blow-flame, the concrete seemed to disintegrate as if it contained water.



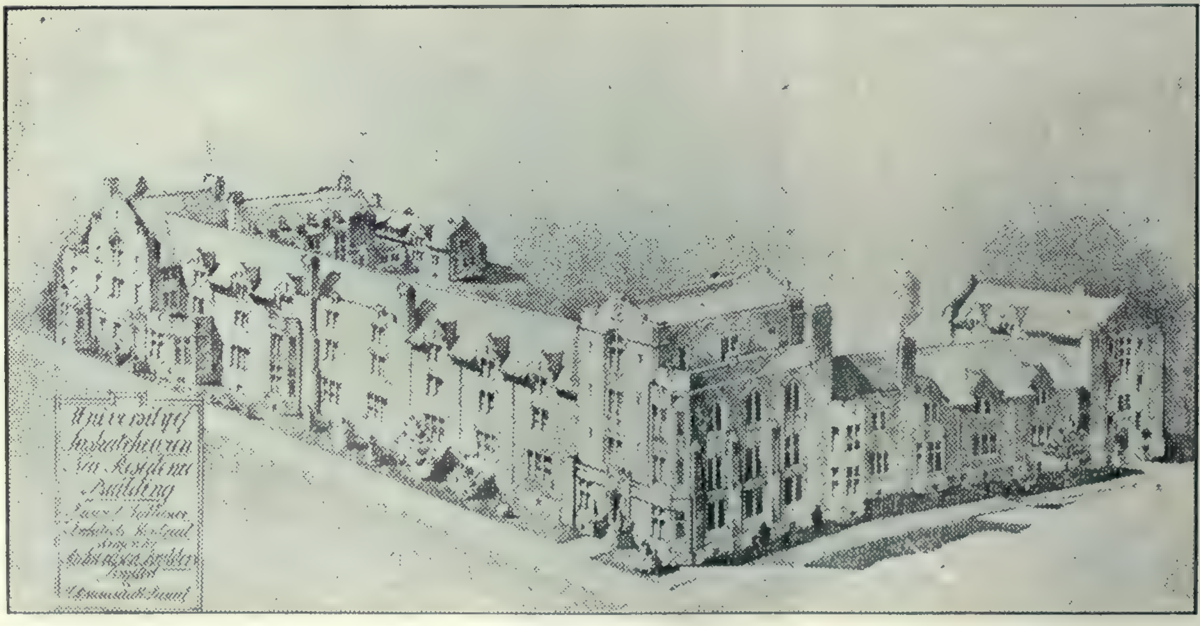
Saskatchewan University Residence under construction.

New Residence for Students of the University of Saskatchewan

By George T. Clark, C. E.

THE increase in attendance at the University of Saskatchewan has made it imperative that adequate facilities be provided for housing the students of the various faculties. With this object in view, the Provincial Government, on the advice of President Murray and the Board of Governors of the University, have at present under construction their second Students' residence. This building occupies a site on one of the ovals of the University grounds across the driveway from the present residence and in close proximity to the present main building of the University. The first residence was constructed about four years ago, and it is expected that it, along with the building now under construction, will accommodate the students in attendance at the University for a few years at least.

The new residence is of reinforced concrete construction. All the exterior walls are of rubble stone masonry laid up in roughly squared ashlar of local field limestone. This local stone is found in large quantities within a few miles of the University grounds and when built into the walls presents a particularly pleasing color effect. This is due to the fact that some of the stones are of a reddish-purple hue which seems



Architect's perspective of the complete scheme.

to diffuse itself over the surface of the whole wall. The trimmings are all of Bedford limestone. All the steps and platforms to entrance doors, base course and basement window sills are of Stanstead gray granite.

The whole of the desk and sloping roofs have timber studs securely fastened to the concrete. The tops of the studs are covered with inch lumber. The desk roof is then covered with tar and gravel and the sloping roof with first quality unfading green slate. The roof system over the dining room consists of steel trusses supported by steel columns set in the rubble walls.

The floors throughout the building are concrete slabs reinforced with Kahn bars. The finished floor in all bedrooms, lounge rooms, corridors and dining room is of clear quality maple. All lavatories, bathrooms, swimming tank room, promenades and stairhalls in basement are laid with terrazzo flooring. The doorways off lobbies, stair-halls and vestibules have thresholds of Italian marble, and the rooms with terrazzo flooring have marble bases and borders. All stairs are ornamental iron with marble treads.

The building is equipped with two elevators—one of fifteen hundred pounds capacity running from basement to attic, the other of one thousand pounds capacity running from basement to ground floor. Automatic doors control the entrances to the elevators at each door.

All outside permanent windows have sashes of rolled steel sections of Henry Hope & Sons' manufacture. These sashes are glazed with thirty-two ounce glazing glass. The panels of vestibules and outside doors are glazed with polished plate glass.

Heat, light and water are supplied to the new building from the central power house, and are conducted to it through a concrete tunnel.

The basement is divided into a large storage room, a common room, a swimming tank, shower room and dressing rooms. The swimming tank is fifty feet long by twenty feet wide and is ten feet deep at the deepest end. This is installed not only for the use of the students in this particular residence, but also to be used in conjunction with the gymnasium, which will be one of the most recent additions to University life. A large dining hall, a lounge room and bedrooms take up all the space on the ground floor. The first and second floors contain bedrooms and lounge rooms, while in the tower on the third floor is the hospital.

The architects for this University residence are Brown & Vallance, of Montreal. The local general contractors are Messrs. Richardson Builders, Limited, Saskatoon.

The contract price of the new building is $185,000. It is expected that the structure will be completed next spring.

Liquid chloride for water treatment at Milwaukee, Wis., is being considered as a substitute for the hypochlorite treatment now employed. The main reason is that in winter, when the lake water is very cold, the chemical reaction with hypochlorite is not the same as in water of ordinary temperature, and as a result it is impossible to avoid taste in the treated water. This causes complaints from consumers, some of whom fear the water is unfit to drink. It is expected that the liquid chlorine treatment will eliminate this trouble, besides saving cost of material, and eliminating the extra labor force employed to apply the hypochlorite. The hypochlorite treatment was used intermittently at first, but is now being used continuously.

Cracks in Concrete Roads

IN view of the importance of the fact that cracking of concrete roads is generally considered to be one of the most serious objections to them and the most difficult to avoid, the Municipal Journal expresses the opinion that sufficient attention has not been given by engineers and road builders generally to the report of the committee of the National Conference on Concrete Road Building concerning the contraction and expansion of concrete roads, based largely on investigations made by the U. S. Bureau of Standards.

One of the most important features of this report, as well as that which undoubtedly seemed the most novel to many, was the statement and apparent proof that not only does concrete expand with the absorption of moisture and contract as it dries out, but that this effort of temperature changes and may be sufficient to cause a stress in the concrete opposite to that which would be caused by a normal temperature change. Moreover, this effect of moisture absorption and drying out apparently continues throughout the life of the concrete. It would seem to follow, therefore, states the committee, " that the condition that would provide for a decrease in moisture content when the temperature increases and an increase in the moisture content when the temperature decreases, would be an ideal one."

The experiments made also indicate that variation in the quality of the concrete will cause a variation in the tendency to expand and contract with change in moisture content, as dense mixtures absorb moisture less rapidly than porous ones. Consequently, if there are two qualities of concrete in a road existing either as a top and bottom layer or in two masses (such as two successive batches of slightly different mixture) occurring side by side, the more porous of the two would have a tendency to expand more than the other and consequently move a greater distance, resulting in tensile stresses and possibly in shearing between the two masses of concrete. If the base of a two-course pavement is more porous than the top, the tendency would be for the former to expand and contract more than the latter and thus cause a separation of the two.

The above is the strongest possible argument for securing absolute uniformity in both proportioning and mixing, in order that not only all of the contents of any one batch but also all the batches in a given pavement, shall be as nearly as possible absolutely uniform in composition and homogeneous in structure. How far this is from realization in too many concrete roads is known by many engineers who have given the subject attention.

Another point suggested by this effect of moisture on concrete pavements is the desirability of draining on subgrade. In a number of cases concrete paving has been adopted for certain stretches of road, because they were too soft and moist for macadam construction, and the assumption is made that dampness under a concrete pavement does not injure it in any way. If the soil and the pavement are kept uniformly damp all the time, this would probably be true, assuming that the dampness has no other effect. The committee, however, calls attention to the probable effects of frost in the subgrade, due to the expansion of the soil when the moisture in it freezes. If the subgrade is dry, there will, of course, be no such freezing and consequent expansion. On the other hand, if the soil be wet and the temperature falls sufficiently low, there will be freezing and expansion. If this freezing and expansion are uniform across the entire width of the road, and if the frost likewise leapes the ground uniformly throughout the width, thus allowing the pavement to settle uniformly, there may be no objectionable results. The committee remarked, however, that it is reported that cracks in concrete usually appear during a thaw rather than during a frost, and that this may be explained by the fact that the heat may be transmitted more rapidly through the shoulders than through the centre of the road, thus causing the sides of the paving to settle more rapidly than the centre. On the other hand, it seems probable that the action of frost will occur sooner and be more considerable along the edges than in the centre. The result of this double action would be the raising of the edges of the road during freezing, thus causing a longitudinal medial crack on the underside of the pavement which would not show, followed by the opening of the pavement above this crack on its top surface as, during the subsequent thaw, the shoulders settle more rapidly than the centre. This explanation would account for the frequent occurrence of long cracks down through the centre of concrete pavements and also of many other kinds of pavements which are laid on concrete foundations. If this explanation is correct, the drainage of the sub-grade of concrete and concrete-foundation roads would appear as essential as in the case of the various kinds of macadams.

The committee, in view of their investigations, advises that the best mixture is that which is most dense, that the concrete should be mixed and placed in such a way as to produce a product of uniform quality; that the sub-base should always be thoroughly wet before the concrete is placed to prevent rapid drying out, and that the concerte should be kept moist until it is strong enough to resist the stresses which will be caused by contraction due to drying out.

As to the effect of length of slab upon transverse cracks, the committee gives 25 feet as the maximum length for slabs in localities where there is little rainfall, while in localities where the rainfall is intermittent and the ground water rises in cool seasons and lowers in warm seasons the length may vary from 30 feet to a continuous slab. The length of slab should vary with the quality of the concrete, since the denser concrete will absorb less moisture and consequently have less tendency to move. The length should also vary with the condition of the sub-grade. If smooth on a steep grade, the slab should be made shorter to avoid the tendency to slide down hill. Where there is any decided change along the length of the road in conditions of smoothness of sub-grade, a joint should be placed at the point where this change occurs.

The thickness of the slab also may be considered in determining the length, since the greater the thickness the greater the strength of a horizontal foot of cross-section, and this increase is greater than the increase in resistance to motion due to friction between the concrete and the sub-grade.

Experiments indicate that there is greater movement in a concrete pavement or concrete base covered with a bituminous carpet than in that uncovered, the reason for which probably is that a dark surface absorbs more sun heat and also that the bituminous coating causes the concrete to retain for a longer period any moisture which gets beneath and into it.

The committee does not believe that the width of slab affects transverse cracking.

It favors a dished subgrade under all climatic conditions as being best able to resist tendencies to longitudinal cracks.

As to reinforcements, it recommends this when foundations are uncertain; in regions where there is little rainfall and long or wide slabs are desired, or where there is insufficient water for curing; when it is necessary to have a thin slab; when a decided change in grades occurs; when the movement of the concrete is restrained, as at street intersections or on curves, if joints cannot be placed properly; when the width of the slab is greater than 25 feet; or when it is necessary to crown the sub-grade and the slab cannot be made thicker at the crown than at the sides. Fabricated steel should be used in that form which will give the greatest distribution. Where the reinforcement should be placed depends upon what conditions seem to demand it, it being placed nearer to that surface which will be placed under tension by such conditions. When used to resist stresses due to temperature and moisture changes, it should be placed near the bottom. Ordinarily, it is unnecessary to provide for temperature stresses, which are insignificant compared to those of moisture.

Where a road is constructed without joints, with the idea that nature will provide the joints where most needed, the concrete will weaken for some distance on each side of the place where the crack occurs, which may result in a partial disintegration of the concrete. There is, of course, the additional objection that the cracks will be irregular in line and more objectionable in appearance than with a straight joint. The thinner a joint the better, since stresses caused by expansion are readily absorbed by the concrete, and the less actual expansion permitted the less will be the movement from contraction and consequently the tensile stresses which produce cracking.

Uniformity in the sub-grade is very important, this applying to both the compactness and the smoothness, since unequal compactness will allow unequal settlement and unequal smoothness will allow unequal motion in different parts of the pavement, both of which will produce stresses unequally distributed and therefore more likely to produce cracks.

Among individual suggestions made in the discussion were the following: R. J. Wig, of the Bureau of Standards, chairman of the committee, believes that joints should be constructed as contraction joints, providing little or no room for expansion.

W. A. McIntyre emphasized the necessity of making the joint perpendicular to the surface of the pavement, because of the tendency otherwise for one slab to lift up onto the other when expansion occurs.

The Committee on Joints reported that "expansion joints should be kept filled to the level of the pavement surface so that there will not result an impact when wheels cross the joint. If the joint is not kept filled, grit will accumulate and in time the joint will be filled with non-elastic material. Even a joint which has been kept filled will in time become jammed with grit."

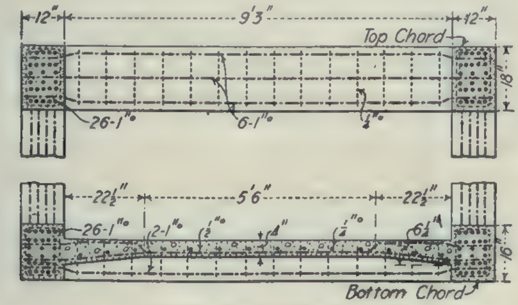
This point was also referred to by H. D. Kerr, who said that when the elastic material has spueezed out in hot weather or been worn away, the joints should be cleaned out and refilled; one reason for this being to prevent the penetration of water through the joint to the sub-grade.

Large Trussed Concrete Bridge

REINFORCED concrete bow-string bridge of 162-ft. span, designed for a live load of 80 lb. per square foot and a wind pressure of 30 lb. per square foot, has been built at La Louviede, Belgium, and is described in a recent issue ofThe Engineering Record. The clear width between trusses is 9 ft. 3 ins., the structure being uesd solely by pedestrians. It is believed to be the longest of its kind. The design is shown in the accompanyng drawing . The top chord is a parabola and has a uniform cross-section of 12 x 18 ins. The bottom chord is suspended by 12 x 16-in. verticals and serves as a tension member to resist the horizontal component of the end reactions. Nine 16 x 18-in. struts located at panel points provide overhead bracing to stiffen the compression chords.

Floor

The floor is figured as a slab spanning the distance between trusses. It is 4 ins. thick at the centre, the thickness at points of support being increased to 6¼ ins. in order to take care of the increase in vertical shear. Because of the heavy reaction of 65 tons, the bearings at the ends of the trusses have been designed in the same way as for a steel bridge. The upper parts of the roller bearings are fastened to the truss by three horizontal bolts, inclosed in pipes so that they can be easily removed.



Cross-section of trussed bridge.

The permissible unit stresses in steel and concrete were selected in accordance with the rules for Belgian highway bridges, and amounted to 710 lbs. per square inch for concrete in compression and 17,070 lbs. per square inch for steel.

Camber to Take Care of Deflections

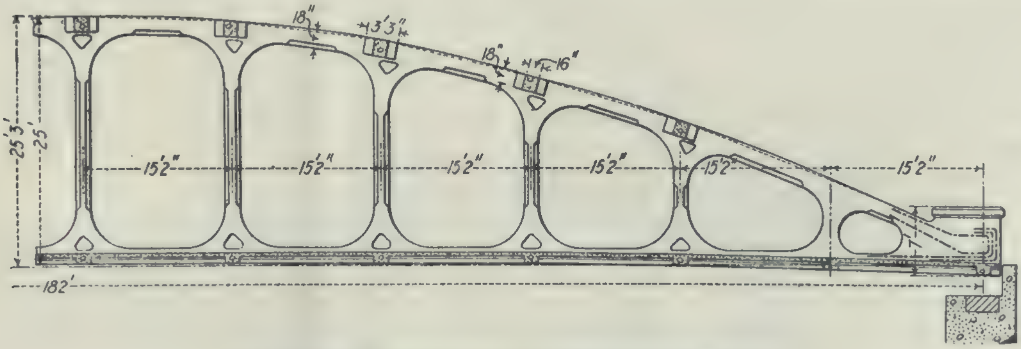
A 3-in. camber was provided to take care of deflections. The maximum permissible deflection for a full live load of 80 lbs. per square foot was 2.2 ins., but under the test load the actual deflection at the centre was only 0.47 in. In accordance with the wish of the designer impact tests were also made. Twenty-four workmen marched over the bridge in both directions and afterward assembled at the centre of the bridge and jumped five to six times. Under the first test a wave action was created which at no point exceeded 0.12; under the jumping-test this wave action increased to 0.20 in..

The bridge was designed by Professor Vierendeel, of Bruges, and the work was executed by Grondel Brothers, of Ghent, Belgium.

In an article on the Transcontinental Railway Company's air-lift plant at the new Quebec Bridge in the Contract Record of November 11, it was inadvertently stated that the air lift delivered over 4,500 Imperial gallons per hour into a tank having a capacity of 70,000 gallons. The statement should have been **5,500 Imperial gallons** per hour.

The Oklahoma Geological Survey has just issued a new State map. The existing maps were found to be lacking, especially as to the proper location of railroads and also of some of the smaller towns. The general procedure in making the map was as follows: The network of 30 miles in latitude and longitude was constructed as a base. On this was imposed the areas covered by the U. S. Geological Survey. The balance of the State was filled in according to the U. S. Post Route Maps of 1914. Requests for information were also made to the different county surveyors. Finally, by courtesy of the different railroad companies the surveys of sections through which they passed was added. The map is not put out as being entirely correct, as limitation of funds prevented an extensive survey.

Modern street paving is as yet practically unknown throughout Japan. The usual Japanese street has no footway, and no attempts have been made to provide separate roadways for pedestrians outside the business districts of the more important cities. These streets have no artificial paving, they are usually macadamized in as cheap a way as possible, and are in bad condition at all times of the year in the congested traffic districts. In the city of Tokyo, where there is a population of some 2,000,000, there is only one steam roller employed on these pavings, and that is usually out of order. In Yokohama a few of the business streets have cement footways, but none of the streets are paved. Yokohama has a population of about 400,000, and a street mileage about equal to that of any city of like population.



Half elevation of bridge showing arrangement of truss members.

Concrete Roads—Their Design, Specifications and Present Status*

By A. A. Young

IN the last five or six years engineers and corporations have given increasing attention and importance to the use of concrete (without a surface coating) as a paving material. Within that period concrete has practically become a requisite as a sub-base for all surfaced pavements. The logical development was that someone would experiment with concrete alone as a pavement, so that to-day there are 2,000 miles of concrete road in the United States and 40 miles in Canada. In the following paper the writer will take up, first, the development of the design for concrete roads; second, the specification for the same; third, the present status.

DESIGN

In bringing forward concrete (without a covering) as a pavement, engineers and corporations were given confidence by the fact that Bellefontaine, Ohio, has a concrete pavement which at that time (six years ago) had been down fourteen years. It was laid as a sidewalk, in slabs or small blocks, in two courses of 5-inch base and 2-inch top surface. It shows no cracking and very little evidence of wear and abrasion even at the present time. Engineers appeared to stop at this investigation and instead of following out the design used by the Bellefontaine people, they went back to their experience with concrete base for a surfaced road. The result was, that in most localities, long stretches of concrete road were laid on a more or less compact base in widths from 12 to 24 feet and 6 or 7 inches thick, in which the mixture was low in cement, and drainage of the subgrade, evenness of the surface of the concrete and expansion and contraction received little or no attention. In reading up reports on concrete roads, the writer found that nearly every locality had a piece of this type of road constructed, even when improvements with a slight increase in cost were going on in other districts. That is, the engineers in charge, or possibly the corporations supplying the funds, did not benefit by the experience of other localities, but preferred to experiment for themselves. The result is that now we have a large number of poor pieces of concrete road which are used to good purpose as detrimental to the present standing of this type of pavement. Very soon there appeared in these stretches numerous longitudinal and traverse cracks and excessive wear under traffic. These two faults—cracking and abrasion—have ever since been the object of all experiment and study in this type of road building. The main points of design which affect these two features are: expansion and contraction; thickness and width; grade; crown; mixture.

Designs and specifications vary greatly according to the requirements and local conditions, therefore no attempt can be made to give a definite design. All that can be done is to give an outline of the different features which should be considered in working out the same.

Expansion and Contraction.—The chief conditions affecting expansion and contraction are: 1, changes in temperature; 2, changes in the moisture content; 3, variations in the condition and character of the sub-base.

1. The theoretical change in the length of concrete due to temperature changes is commonly taken as 0,000006 per degree per unit of length. Taking a normal range of temperature of 140 degrees in our northern climate, the movement which would occur, due to this influence alone, would be 0.00084 per unit of length.

2. Experiments with concrete subjected to moisture and drying show: (1) that concrete expands with moisture and contracts on drying out; (2) that the rate of contraction is faster than the rate of expansion, being probably about twice as fast; (3) the change in length in contraction after three months is about 0.0005 per unit of length in concrete of ordinary consistency and mixture.

3. The character and condition of the sub-base contraction and expansion: 1, by varying the amount of moisture under the concrete; 2, friction or resistance offered by the sub-grade to the concrete slab. The rougher the sub-grade, the greater is this resistance, with a corresponding increase in the stresses. Although these are compressive in expansion, in contraction they are tensile and need consideration.

If a concrete road is built with the idea that nature will provide cracks for contraction and expansion, the pavement will crack, but only after causing a weakening of the concrete for some distance on each side of the opening, as is evidenced by short forked cracks running off the main crack. These may result in a partial disintegration of the road. If contraction joints are provided, they relieve these heavy stresses and lessen to a great extent the weakening of the concrete.

When a stretch of concrete is setting up or taking its initial set, it contracts and shrinks. The tensile strength of the concrete in this state is very small and lines of weakness are formed which may not show at first, but when the subsequent contraction due to moisture content and temperature changes takes place, these lines of weakness develop into cracks. For this reason the length of the slab is made small, in fact, the shorter the slab the stronger it will be to resist tension. As the moisture and temperature of the concrete and the conditions of the subgrade at the time of placing all affect the contraction at that time, it has been found difficult to calculate the proper length of slab. This distance has been derived by experiment and 16 to 30 feet is the accepted length, 16 feet being absolutely safe and 25 feet common practice. Roads have been built successfully with much longer slabs, even up to 50 feet, but the conditions there must undoubtedly have been favorable. As the conditions are changeable, and more or less uncontrollable, the smaller lengths are safer. This range of lengths can be increased by the use of reinforcement where other conditions warrant the increase in length. The type of reinforcing used is usually triangular wire mesh.

Having decided on the position of the joint, the question arises as to the maintenance of this joint. This includes the amount and type of filler and the protection of the joint. From the paragraphs on moisture content and temperature changes, the maximum expansion possible under the most favorable conditions is seen to be about 0.001 per unit length. For a slab 25 feet long this works out to 3/8 inch. Now the shrinkage is usually about 1/8 inch when the concrete sets, so a space of 1/4 inch will cover the greatest possible expansion. This is the usual practice, with a tendency to the smaller space of 1/8 inch, because we practically never have the combination of circumstances which gives this maximum expansion.

The following are the usual methods of making the joint: (1) a tar felt paper joint 1/8 to 1/4 inch thick with no protection; (2) a tar felt paper joint 1/8 to 1/4 inch thick with the edges of the concrete rounded with a sidewalk tool; (3) a tar felt paper joint 1/8 to 1/4 in. thick with plates of soft steel 1/4 inch by 3 inches on each side, which are flush with the concrete and wear with it; (4) the same as (3) with tar filling; (5) a wider joint with wooden creosote blocks between, which are placed flush with the concrete and which broom down as the concrete wears.

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*Paper read before the Manitoba Branch of the Canadian Society of Civil Engineers.

Of all these (3), that of the soft steel protection with the felt paper as a filler, is the one most commonly used, is fairly reasonable in price and easily constructed.

Thickness and Width

A careful investigation of the thickness of pavement used in the various districts shows that they range from 6 to 8 inches, with a tendency at the present time towards the greater thickness at the centre of the road. This is significant when we consider that in road-making in the older countries of Europe they do not hesitate to put down 8, 10, and even 12 inches, length of life being considered an essential feature in the calculation of the cost of the pavement. Let us assume, therefore, that 7 or 8 inches at the centre is a thickness which will not place the cost over that usually spent on a permanent road. At the present time three general ideas of design of width relative to thickness prevail.

1. To lay the pavement in small sections after the design of sidewalks, about 7 inches thick. This is not generally used, but a pavement of this type in Bellefontaine, Ohio, has given over 20 years' service with a very small maintenance cost and no cracking.

2. To lay the pavement in slabs the widtn of the road required and the length permitted by expansion and contraction, thickness being from 6 to 8 inches. This is the usual design and up to the present has met with varying success. There is a tendency for a central crack to develop in the wider pavements, the number of slabs having these cracks increasing a little, year after year. The cracking has been reduced and in some cases eliminated by using mesh reinforcement. Of course, there are a few exceptional cases where this design without reinforcement has been used and no cracks have developed.

3. To lay the pavement in slabs not greater than 12 to 16 feet in width, depending on the load, a longitudinal joint being placed in the pavement where widths greater than these are required. The thickness used is 6 to 8 inches. This is a new design and only one or two pieces of it have been laid within the last two years, consequently its success cannot yet be ascertained.

These various designs seemed to be based on different assumptions as to the bearing of the concrete on the subgrade and their success or failure can usually be traced to the condition of the subgrade or the provision made for contraction.

Let us consider design No. 1, in which the sidewalk slab is used. Its success is probably due to the fact that it is designed to meet the worst conditions, that of settlement of the subgrade at the outside edges of the pavement and that of poor drainage. Where the subgrade settles at the edges under a slab the full width of the road, severe tensile stresses are set up in the central portion and extreme thicknesses of concrete are required to carry this cantilever action, as shown in tables No. 1 and No. 2 for 1:1½:3 concrete.

Table No. 1

Modulus of Rupture in Tension 400 lbs. per sq. in. F. S. = 2.

Load	6 ft. wide	8 ft. wide	10 ft. wide	12 ft. wide	16 ft. wide
6 tons	6.7	8.4	10.2	12.9	18.8
8 tons	7.6	9.2	11.3	14.2	20.2

The figures are thicknesses in inches of plain concrete to carry cantilever loads on an arm of half the width of pavement. One inch should be added for wear.

Table No. 2

C = 750 lbs. per sq. in. S = 16,000 lbs. per sq. in. P = 0.0061.
Load = 8 tons.

	10 ft. wide	12 ft. wide	16 ft. wide
Thickness of concrete in inches	6.2	8.4	10.9
Sect. area steel, sq. in. per lin. ft. road.	0.45	0.61	0.80
Lbs. steel per lin. ft. road	10.3	16.7	29.0
Cost per sq. yd. at 4c. per lb.	37.4c.	50.0c.	65.0c.
Equiv. thickness concrete at 25c. per sq. yd. thickness	1.5	2.0	2.6
Total equivalent thickness	7.7	10.4	13.5

This table gives thicknesses of concrete and lbs. of steel to carry cantilever loads on an arm of half the width of pavement, reduced to equivalent thicknesses in inches of plain concrete. Steel is placed in the centre two-thirds of the width. One inch to be added for wear.

From table No. 1 it is seen that if we assume settlement, we must make the slabs in sidewalk sizes in order to have an economical thickness of concrete. This is not generally used on account of the possible roughness or jarring due to so many joints, and because settlement is a thing which can be obviated by careful construction methods at a very slight increase in cost over careless methods. A study of tables No. 1 and 2 will emphasize the absolute necessity of care in grading, as they show the thicknesses required at the centre in wider pavements if settlement is allowed and these thicknesses both in plain and in reinforced concrete are prohibitive in price.

Design No. 2, in which the slab is the entire width of the pavement. Grading is a part of construction and can be governed, but the effects of moisture and frost which may occur alternately four or five times a year, are difficult to provide against. It is usual to put down drains on each side of the pavement and endeavor to keep the moisture level at least two feet below the concrete. In soils which are self-draining and pervious there is very little capillary moisture and then the effect of moisture and frost may be neglected. In soils which are difficult to drain moisture and frost under the edges of the pavement tend to raise it and give a simple beam action. Tables Nos. 3 and 4 give the thickness at the centre of a pavement of plain concrete (1:1½:3), and equivalent thicknesses of reinforced concrete for various widths to carry this beam action.

Table No. 3

Modulus of Rupture in Tension=400 lbs. per sq. in. F. S.=2.

Load	8 ft. wide	10 ft. wide	12 ft. wide	16 ft. wide	20 ft. wide	24 ft. wide
6 tons	4.0	5.6	6.5	8.1	11.3	13.0
8 tons	4.5	6.1	7.1	9.5	12.2	15.8

This table gives the thicknesses required to carry a load on a simple beam supported at the outside edges of the pavement, over a span of two-thirds the width. One inch should be added to these figures for wear.

Table No. 4

C = 750 lbs. per sq. in. S = 16,000 lbs. per sq. in. P = 0.0061.
Load = 8 tons.

	10 ft. wide	12 ft. wide	16 ft. wide	24 ft. wide
Thickness of the concrete, inches ...	4.3	5.5	6.0	9.0
Sect. area steel, sq. in. per lin. ft. of road	0.25	0.31	0.38	0.59
Lbs. of steel per lin. ft. of road ...	5.7	8.5	13.8	32.1
Cost per sq. yd. at 4c. per lb.	20.0c.	25.4c.	31.0c.	48.0c.
Equiv. thickness concrete at 25c. sq. yd., inches	0.8	1.0	1.2	1.9
Total equivalent thickness	5.1	6.5	7.2	10.9

This table gives the thicknesses of concrete and lbs. of steel to carry the load on a simple beam supported at the edges of the pavement, reduced to equivalent thickness of concrete in inches. The steel is placed in the centre two-thirds of the width. One inch to be added for wear.

The varying success of design No. 2 is due to the use of practically the same thickness of concrete for all widths of road and upon all soils. Now, in cases where no cracking occurred, the subgrade, besides being well rolled and prepared, was well drained, while in the cases where the longitudinal cracking occurred inside the first year, the most of it is probably due to settlement and a little to frost and moisture; and the additional cracks from year to year are undoubtedly due to moisture and frost. From tables Nos. 3 and 4 it is seen that if the drainage is uncertain, 12 to 16 feet is the widest slab that can be made of the economical thickness, 8 inches being too small a thickness for pavements wider than 16 feet.

This leads to design No. 3, where the longitudinal joint is introduced. This longitudinal joint divides the pavement into widths which permit an economical thickness and retain the required strength against beam action. It is a recent idea and has been little used so far, but it is inexpensive—being equivalent to not more than one-half inch thickness per sq. yard of concrete. The only drawback to roads of this type is that they are difficult to construct satisfactorily, as the protection plates used for the transverse points are not sufficiently solid for longitudinal joints. However, with comparatively little improvement, this design will be worthy of consideration as it permits movements of the edges of the pavement without cracking. Even in the small widths this method results in the saving of an inch or so in thickness of concrete.

From this discussion and the above tables, it is evident that the greatest possible stress is at the centre of the slab and, therefore, the greatest thickness is necessary at that point. The stress will be less towards the edge and the thickness may be reduced there.

The wear of traffic on small pavement is more at the centre, while on the wider pavements it is more evenly distributed. Generally speaking the wear at the outside edge of the pavement is negligible. For these two reasons, common practice is to make the outside thickness of concrete about 5 or 6 inches.

Summing up this discussion we may say that thickness and width are made such as to be economical and to eliminate cracking. The two main causes of cracking are settlement of thhe subgrade at the outside edges and action of moisture on the subgrade at the edges. Settlement of the subgrade is the result of poor workmanship and is preventable; action of moisture on the subgrade is due to natural causes and in a great many soils is uncontrollable. Tables 1 and 2 demonstrate that the subgrade must be properly compacted as it is not economical to design the concrete to cover this defect. The drainage possibilities then govern the width and thickness. Tables 3 and 4 show that only in the case of self draining soils should the pavement be wider than 16 feet, longitudinal joints being advisable for the greater widths. The prevailing idea of the design should be to reduce the tensile stresses due to contraction and beam action and to increase the tensile strength.

Gradee.—Concrete may be used on any grades on which other hard surfaced pavements can be used. On grades steeper than 3 or 4 per cent., shallow corrugations will be found of assistance and they are a necessity with grades of 5 per cent. and over.

Crown.—A study of the crowns of the surface used on concrete roads of America, shows that they range from 1/48th of the width to 1/160th of the width, but the great majority are between 1/70th and 1/100th of the width. A common practice is 1/96th. Where curb and gutter are used, in order to prevent an undue proportion of the pavement being covered with water, a peaked crown is used. That is, ⅞th of the rise is at ¼ the distance from the centre to the curb and ⅝th at half the distance.

From the crown of the surface and the thickness required for the width of the slab, the shape of the subgrade may be established. The subgrade should be made to conform with the design of the slab, that is, the crown of the subgrade should not be established first and the thickness then made to be the amount between it and the crown of the concrete.

Mixture.—So far cracking has been the topic of discussion, the question of wear and abrasion is also an important consideration in design. In the early pavements where the materials and mixture received insufficient attention, a great deal of ravelling occurred. This was not really wear, but rather the breaking up of the bond of the materials by the traffic. Improvements have been made from time to time until now the wear of concrete is considered merely a matter of inspection and workmanship.

About a year ago a very interesting test of various mixtures was made in Chicago. Narrow slabs of different mixtures were made up and placed in a circle, from the centre of which two arms were rotated. On each of these arms was a heavy wheel weighing 1,400 lbs. with three-inch iron tires, and at intervals on the circumference of the wheels, shoes were placed alongside, which gave blows similar to those of horse hoofs. These wheels were so arranged as to move 27 inches along the radius or arm as they rotated. In this way each slab was subjected to the same wear, which was similar to that caused by horses hoofs and heavy wagons. Table No. 5 shows the results after 20,700 rotations of the machine.

Table No. 5

No.	Mixture	Wear (inches)	Remarks
1.	1:1½:3 screened gravel ¼"-1½"	0.19	Uniform wear, rough
2.	1:1½:3 granite (4 parts 1"-1½." "3 parts ¼"-1"	0.11	Uniform wear, perfect condition
3.	1:2½:5 screened gravel ¼"-1½"	1.38	Poor condition
4.	1:2 :4 screened gravel ¼"-1½"	1.77	Poor condition
5.	1:2 :3 screened gravel ¼"-1½"	0.24	Uniform wear, rough
6.	Top course 1 cement: 2 clean sand	0.26	Uniform wear, smooth
7.	Top course 1 cement: 2 mixture (1 part of ¼" granite to 2 parts of ¼"-¾" granite	0.18	Fairly uniform
8.	1:1½:3 crushed limestone ¼"-1½"	0.13	Uniform wear, smooth
9.	1:2 :4 crushed limestone	0.44	Uneven, rough
10.	1:2 :4 crushed limestone (4 parts 1"-1½", 3 parts ¼"-1")	0.16	Uneven, rough

zFrom this table, comparison of different mixtures of the same materials and comparisons of the same mixtures of different materials can be made. The main conclusions are:

1. The mixtures with granite show less wear than that of the same mixture of limestone or screened gravel or that of the sand top course.

2. From test pieces 1, 3, 4 and 5, test pieces 2 and 10 and 8 and 9, it is demonstrated that under the most severe traffic conditions the 1:1½:3 mixture gives a satisfactory wearing surface and that the mixtures containing less cement will not withstand the impact and abrasion of traffic in a degree at all comparable with the richer mixtures.

3. From test pieces 2 and 7, it is seen that the mixtures with the higher percentage large sized aggregate give a better wearing surface.

4. From test pieces 1 and 5, it is evident that an increase in the amount of fine aggregate slightly decreases the resistance to wear, and test 6 shows that a top course of sand and cement decreases the resistance to wear still more, although the difference in either case is not great enough to warrant placing the mixture out of consideration.

5. The tests also show that in the case of the keener mixtures it is much more difficult, even in the laboratory sections, to obtain an even surface that would resist the pounding of the traffic.

6. The order of resistance shown in the test was as follows:—1, 1:1½:3 granite; 2, 1:1½:3 crushed limestone; 3, 1:1½:3 screened gravel; 4, 1:2:3 screened gravel; 5, ½ sand top course.

7. The remaining mixtures should not be considered where the traffic is at all heavy.

This test proves conclusively that rich mixtures are necessary to secure a bonding of the concrete which will prevent the large aggregate of the mixture being torn out by the traffic.

(Concluded next issue)

Personal Mention

Mr. A. W. E. Fawkes, waterworks engineer for the city of Calgary, has resigned and opened an office in the Burns Building, Calgary, to carry on a general engineering practice.

Mr. H. G. Hawley, associate engineer on Federal drainage work in Alabama, has returned to become associate engineer of the Canadian Pacific Railroad, with office at Minneapolis.

Mr. J. Vipond Davies, vice-president of Jacobs & Davies, Inc., consulting engineers, New York City, was awarded by the Institution of Civil Engineers, London, Eng., the Telford gold medal of that institution for his paper on the "Extension of the Hudson River Tunnels of the Hudson & Manhattan Railroad." The Telford gold medal is the premier medal of the institution and dates back to 1835, funds for the purpose having been bequeathed by the celebrated engineer, Thomas Telford, the first president of the institution, 1820 to 1835.

Mr. William B. Bryan, chief engineer of the Metropolitan Water Board of London, died recently. He was born in 1848 and began an official career in 1870. In 1882 he was appointed chief engineer of the East London Waterworks Company, remaining as water engineer to the Borough of Blackburn until the completion of new waterworks. In 1904 he took up the appointment of chief engineer to the Metropolitan Water Board. Mr. Bryan was a member of the Franklin Institute, of Philadelphia, and of the New England Waterworks Association, besides many English technical societies.

Mainly Constructional

East and West—From Coast to Coast

EASTERN CANADA

At St. Felicien, Que., a stone church erected at a cost of Jos. P. Ouellet, 28 Ste. Famille Street, Quebec.

At Hamilton a six-storey departmental store is to be erected by Mr. John Lennox. Plans have been prepared.

The ratepayers of Ottawa will vote January 4 on a by-law to raise $250,000 for the construction of an intercepting sewer.

The city of Berlin, Ont., will submit a by-law to raise $14,000 for the installation of an incinerator. The contract will go to the Ideal Incinerator Company, Toronto.

Included in the budget estimates of the Montreal Council is $50,000 for an improved lighting system, postponed from this year, and also $92,000 for a new police signal system.

The West Lake Brick & Products Company, Limited, Wellington, Ont., has been incorporated with a capital of $250,000. Mr. H. A. Rose, Sr., of Welland, Ont., is identified with the enterpirse.

As the result of a conference between the Montreal Harbour Commissioners and the Minister of Marine, the proposed addition to the west end of No. 1 elevator has been postponed until the spring.

At a meeting of the Royal Canadian Institute held at the University of Toronto on Saturday, November 14th, Prof. Angus gave an address entitled "The Proposed Waterworks System for Toronto."

The Board of Education at Toronto is to spend $100,000 upon the erection of a new building to house its various departments. It is to be erected on the south side of the present Central Technical High School, on College Street.

Professor T. L. Walker, of the University of Toronto, gave an interesting address before the members of the Engineers' Club of Toronto on Friday, November 20. He took for his subject his experiences in Germany after the declaration of war.

Messrs. Ross & Macdonald, Montreal, are now drawing plans for a proposed large office and loft building at Mayor and St. Alexander Streets, Montreal, for Mr. H. B. Mussen. The site cost $210,000. The work will not commence until the war is over.

Exterior work is proceeding on the new Loyola College which is being erected at Notre Dame de Grace at a cost of $400,000. The architects are Messrs. Peden & Mclaren and the general contractors are Mesrs. Anglins, Limited, both Montreal firms.

Mr. Richard S. Buck, recently chief engineer of the Dominion Bridge Company, Canada, and previously with the engineering firm of Sanderson & Porter, New York, has been appointed engineer of maintenance of way of the New York (N. Y.) Railways.

Steel work is in progress in the new soap factory which has been erected at Hamilton by the Proctor-Gamble Company. The building is to be three storeys high, of reinforced concrete and brick construction.

Mr. Chas. D. Campbell, Town Engineer of Galt, has resigned his position as Town Engineer of Preston owing to the increase of duties in the larger municipality. It is stated that the vacancy at Preston will be filled by the appointment of a resident engineer.

The Committee of Management of the International Engineering Congress have issued a pamphlet denying the report recently circulated to the effect that this congress was to be abandoned. The congress will be held in San Francisco, as scheduled, from September 20th to 25th, 1915.

Operations on the apartment house which is being erected for a syndicate on Bay Street, Hamilton, according to plans prepared by Messrs. Stewart & Witton, have reached the roofing stage. The building, which is to cost $100,000 is to be five-storeys high, of reinforced concrete construction.

Toronto reports that the directors of the Humber Beach Hotel, which was destroyed recently by fire, have decided to erect another building on the old site. The new hotel will be a fireproof, brick structure. The work of razing the old building will commence at once. It is hoped to have the new hotel ready by the spring.

Builders' Exchanges and similar organizations have been asked to support a deputation to the Premier in favour of the establishment and maintenance of a central Federal labour bureau and free local bureaux. The question has been before the Government on several occasions and the Cabinet is pledged to introduce a Bill next session.

Operations have been temporarily suspended on the new R. C. church which is being erected at Ville Emard (Montreal) at a cost of $150,000. We are informed that sub-contracts will be awarded when operations are resumed, which will probably be in early spring. The architect is Mr. A. Bergeron, Longue Pointe, and the general contractor is Mr. H. Tessier, Montreal.

Mr. Duncan McCormick, K.C., of Montreal, has been appointed chairman of the permanent board of arbitration between the General Contractors' Association of Montreal and the United Brotherhood of Carpenters and Joiners. This is in connection with the agreement as to wages made between the contractors and several trade unions earlier in the year, the appointment being by the Minister of Labor.

There is a movement under way to construct a Peace Memorial Highway stretching across the province of Ontario from Windsor to Montreal. Details have not yet been worked out, but the idea of the promoters is to secure the co-operation of the municipal bodies and organized motorists of the province. The mileage, outside of urban districts, is estimated at 375 miles and the cost of the whole undertaking is placed at $6,000,000. Mr. W. A. McLean, Provincial Engineer of Highways, has interested himself in the project.

Mr. J. G. Sing, District Engineer at Toronto for the Department of Public Works, has resigned that office and will go into practice as a consulting engineer, acting in an advisory capacity to the Toronto Harbor Commission. It is stated that Mr. M. Wilson, who has been assistant to Mr. Sing, will be promoted District Engineer. Mr. C. H. Mathewson, the present engineer on the government work for the Harbor Board, will temporarily assume charge of the extensive harbor improvements in Toronto, which involve an outlay of $7,000,000, the government's share of the work.

WESTERN CANADA

In the Westmount subdivision of Edmonton a new brick building has been erected for the School Commissioners by the Edinger Construction Company at a cost of $150,000.

Fort George, B.C., was visited last week by a fire which caused a loss of some $150,000. The fire originated from an explosion. The entire east side of Central Avenue was destroyed.

Mr. M. Janse, the Calgary contractor, was in Vancouver recently studying the plans of the grain elevator there. Mr. Janse's firm is building the elevator at Calgary, which is now more than half completed.

A western incorporation worthy of note is that of Canada Grain Securities, Limited, of Winnipeg, a new concern capitalized at $200,000. The company will conduct a general grain business and erect grain elevators and mills.

Arrangements are being made by the Winnipeg Board of Control for the construction of sewers on a number of streets. The total estimated cost of the work planned is $500,000. It is proposed to carry out the work by day labor. Mr. W. P. Brereton is City Engineer of Winnipeg.

Exterior work is advancing rapidly on the stores and offices which are being erected at Edmonton for Messrs. Adams Bros. by the Frid Lewis Company. The building is to be four storeys high, of stone and brick construction. The estimated cost is $150,000. Messrs. Barnes & Gibbs, of Edmonton, are the architects.

At Edmonton, a store and office building is being erected for Mr. J. Kelly by Read, MacDonald & Brewster, general contractors. The building, which is to cost $125,000, is to be five storeys high, of brick and reinforced concrete construction. Operations are now well under way. The architects are Messrs. Van Siclen & Macomber, of Edmonton.

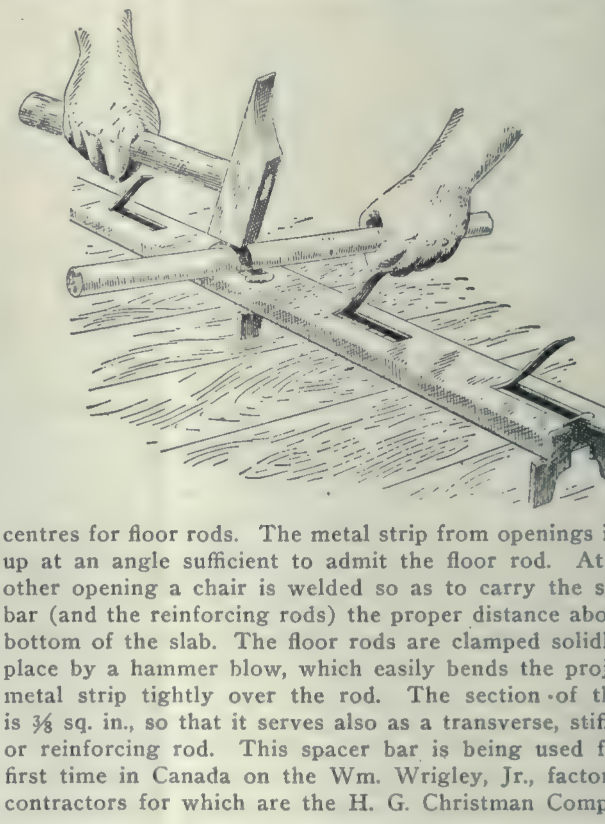
At South Edmonton, Alta., operations have been renewed on the new buildings for the University of Alberta. The general contractors are the Geo. A. Fuller Company, Limited, and the total cost of the undertaking is placed at $450,000. The building now under construction will be four-storeys high, 60 x 375 ft. in dimensions, of stone and brick construction.

Mr. J. W. Stewart, president of the Pacific Great Eastern Railway, announces that construction is proceeding with undiminished vigor all along the route of the new line from the end of steel near Pemberton to Fort George. He said that a force of nearly 7,000 men is engaged in the task of projecting a new line into the interior. Incidentally, he mentioned that a sum aggregating between $1,250,000 and $1,500,000 was being spent each month in the work of construction.

According to advices received by the Hon. Thos. Taylor, construction work is now well advanced on the bridge for the Kettle Valley Railway, which will link the new Hope Mountain route with the C. P. R., on the north side of the Fraser River, near Hope. The first of the bents has been completed, and structural operations are proceeding briskly. The Kettle Valley line has been linked up between Midway and Penticton, and construction work is well advanced towards Princeton, where the railway will join the V. V. & E., and use a joint section to Otter Summit, where connection is made with the Nicola Valley branch of the C. P. R. Grading has been almost completed on the Hope-Coquohalla Summit section of the Hope Mountain route, and it is anticipated that the new line will be ready for traffic to the coast next summer.

The "Efficiency" Spacing Bar

A patented spacing bar for holding reinforcement in place, in concrete slabs, has just been put on the market by the Electric Welding Company of Pittsburgh, who are represented in Toronto by the Railway-Contractors Supply Company, Room 504, Standard Bank Building. The accompanying sketch gives a view of the bar and the method of its uses. It is known as the "Efficiency Spacing Bar." The bar consists of a ¾-inch channel pierced at the required centres for floor rods. The metal strip from openings is bent up at an angle sufficient to admit the floor rod. At every other opening a chair is welded so as to carry the spacing bar (and the reinforcing rods) the proper distance above the bottom of the slab. The floor rods are clamped solidly into place by a hammer blow, which easily bends the projecting metal strip tightly over the rod. The section of the bar is ⅜ sq. in., so that it serves also as a transverse, stiffening, or reinforcing rod. This spacer bar is being used for the first time in Canada on the Wm. Wrigley, Jr., factory, the contractors for which are the H. G. Christman Company.



Large Iron Fence Order

What is generally believed to be the biggest order for ornamental iron fence ever given in Canada, has been placed with the Page Wire Fence Company, at Walkerville. About 3,300 lineal feet will be required to fence in the ten-acre estate of E. Chandler Walker. The total cost of this fence, not including erection, will be in the neighborhood of $7,500. The fence is seven feet high and is composed of three horizontal rails. Pickets are ¾ inch square set 4 inch centres. A new record for quick delivery will probably be made on this order, which was placed in October and is to be delivered complete by December 1st. General Manager Church, of the Page Company, reports an unusually large amount of ornamental iron fence work running through the shops at this time. In fact, the fence business for the past year has been considerably better than it was during 1913, with every indication of a substantial increase in the coming year.

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Alphabetical Index of Advertisers
Page 18

Vol. 28 **December 2, 1914** **No. 48**

Principal Contents

Page
The Clay Products Industry and Its Approaching Convention ... 1449-50
The Greater Winnipeg Water Supply from Shoal Lake ... 1451-4
By D. McLean
Costs of Collecting, Hauling, Transferring and Transporting Refuse Materials ... 1454-6
By Samuel Greeley
Drainage Structures ... 1456-7
By W. E. Atkinson
The Maintenance of Earth Roads ... 1457-8
By Geo. W. Cooley
The Antiquity of Cement ... 1458
Tar-Macadam Work on Roads ... 1458-9
Trade Enquiries ... 1459
The Ontario Street High Level Bridge, St. Catharines, Ont. ... 1459
By Herbert L. Clark
Uses of the Hydraulic Mining Cartridge ... 1460-1
The New Sewage Disposal Plant at Aberdeen, S.D... 1462-70
By W. G. Potter
Economics of Sewage Filters ... 1470-1
Faults of Engineers from the Contractor's Viewpoint 1472
Copper Alloy for Metal Lath Manufacture ... 1472-3
By Clarence W. Noble
Concrete Roads—Their Design, Specifications and Present Status ... 1474-5
The Fourth American Road Congress ... 1475
Constructional News ... 1476-7
Announcement re Clay Products Convention ... 1477

The Clay Products Industry and Its Approaching Convention

IT was well written by Mr. John McLeish, Chief of the Division of Mineral Resources and Statistics, Ottawa, in a special number of this journal some time ago: "The utilization of the mineral and material products of the earth in our present scheme of existence may be said to be of as great importance almost as the production of food or the actual means of sustaining life itself." The quotation may be made aptly in introducing a few thoughts about the forthcoming convention of the Canadian National Clay Products Association, an announcement of which is made elsewhere in this issue.

With clay one of the most abundant of the constructional materials available in this country, and with the status of the industry continually improving as we come to a fuller realization of the wide range and great possibilities of its products, we must take a part in the development of this national association's work and array ourselves on the side of those who are seeking by revised specifications and the interchange of the best manufacturing methods to place the clay-working industry upon a higher plane.

The value of the production of clay products is increasing by leaps and bounds each year and never a season closes but additional evidence comes to hand as to new or improved uses of the material in some form of municipal or building construction. From coast to coast, province by province, brick-making and subsidiary industries are increasing rapidly, both in number and production, and there is not an engineer or contractor in the country who can take the stand—and maintain it—that he is not concerned with the work of striving for higher standards in clay manufacturing.

The first thing to do in approaching the question of higher standards in any industry is to consider the educational facilities at the disposal of those responsible for the product. In the field of clay-working the same principles apply that govern all other spheres of activity. The finest violin in the world would emit nothing but discord were its bow handled by untrained fingers—and it is no less true of clay-working: no matter how many or how vast or how excellent may be our shale deposits, resources and equipment, no matter what the capabilities of the brick or other material, or what chemical and other tests they will survive—if the men in the firing line of the kiln and the plant are ignorant of those fundamentals of testing and chemistry and manufacturing which are essential to the intelligent performance of a workman's or a foreman's part, mediocrity or worse will ensue.

So, then, the question of additional facilities for the clayworker is one of the most important before this comparatively young association and it is a matter which should receive the support of all those who may be in a position to help it forward. The Canadian National Clay Products Association have done creditable work in this field, but the sphere of activity has been localized and the rank and file of the trade throughout the country remain untouched. Much remains—practically all remains—to be done.

What the association wants is more members, more influence and more money, and in the interests of all, whether clayworkers or not, it is to be hoped that these will be forthcoming. In its early days this association experienced the general run of hard times that are the common lot of all beginners, but thanks to the untiring energy of the faithful few the last two or three years have raised the association from a handful of brick and tile makers—with a few machinery men thrown in—to a representative national organization embracing nearly every branch of clayworking manufacture.

Without placing a low estimate upon his predecessors, some of whom were responsible for the hardest of the spade work, we cannot help commending especially the efforts of Mr. Chas. A. Millar, under whose two years' presidency the association has made remarkable progress. When Mr. Millar took the reins of office the affairs of the association had been directed by "men of the old school"—"old-timers"—"boys of the old brigade"—or any other such expression that may be applied to a clique of elderly men who do their best (and a good best) but succeed in restraining every effort at expansion, and remain stationary year after year. Mr. Millar, a comparatively young man, put life and energy into the work and backed it up with the experience which has made him one of the best-informed men in his trade today. The results have been gratifying and it is to be hoped that he may be induced to remain in office.

It promises well for the success of the approaching convention that due regard is to be had to the importance of presenting a programme calculated to be really attractive to the man who takes convention business seriously and hopes to gain from it certain technical information along the particular line in which he is engaged. Latterly there has been an altogether too popular tendency to regard the convention as a holiday jaunt. Nothing is more likely to spell ultimate failure to a trade or technical body than to cater primarily to those whose main purpose in life is to eat, drink and be merry. We all know that a convention without a smoking concert and a banquet is like an egg without salt, but a convention without a properly-organized business session, without carefully-arranged papers and discussions, is beyond criticism and falls into the by-way of disrepute. Doubtless the Executive of the Canadian National Clay Products Association recognize this principle for they already announce addresses by such authorities as Professor Baker, of Queen's University, Dr. McKay, of the Toronto Technical School, and Mr. A. F. Greaves-Walker, ceramic engineer, of Toronto.

The announcement of the meeting comes in good time, allowing a period of preparatory work which should result to good advantage. Clay products men have reached that tide in their affairs which, taken at the flood, leads on to fortune. The "fortune," taken literally, may materialize slowly in view of the depression brought about by the present lamentable war, but applied in the broader and better sense the meaning of the word may soon be realized in a united industry working together for its own advancement and technical attainment, and for the good of all.

* * *

Mr. T. H. Seidl, of Montreal, the Canadian General Manager of Escher Wyss & Company, is a pronounced optimist whose optimism arises out of many encouraging orders and enquiries received since the beginning of the war. Mr. Seidl states that while the war brought about the suspension of a few contracts the average has been maintained by new business. One of the most important orders obtained recently was for two water turbines (each developing 2,300 h.p.) for the Ontario Hydro-electric Power Commission at Eugenia Falls, Ont. The firm has quite a number of smaller contracts on hand and there has been an actual increase in the number of enquiries since the war. This is explained in a measure by the fact that the company's headquarters (Zurich, Switzerland) are located in a neutral country, but in any case it points to business to be obtained. The Montreal office of this firm, of which Mr. Seidl is in charge, has jurisdiction over the business of Canada, Newfoundland and the United States.

* * *

The A. B. Ormsby Company, Limited, Toronto, state that there have been imported from German mills through agents in Montreal and New York large quantities of hot rolled steel sections for use in the building of steel cornices for exterior and interior, steel stair risers and stringers, hand rails for stairs and balconies, steel sections for balustrades, newel posts, steel jambs, steel trims. The company say that they are in a position to substitute for all of this material, steel, cold rolled steel sections and mouldings in any design and in any gauge up to No. 11, which is equal to one-eighth inch in thickness.

* * *

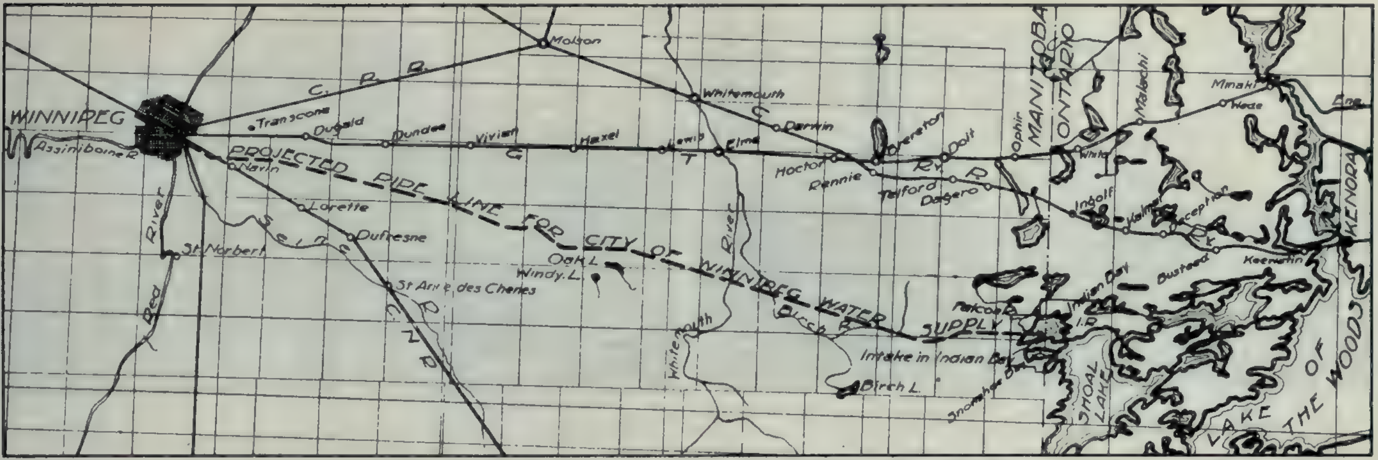
The Australian importations of Portland cement in 1913 were 2,511,828 cwt. (112 lbs.) valued at £264,251, of which Germany supplied. £159,969, Belgium £17,131, and Austria £2,168. The cement is packed in paper-lined casks containing about 350 pounds. Under the general tariff the duty is 24 cents per 112 pounds, and the preferential duty to the United Kingdom only is 18 cents per 112 pounds. Particulars concerning the chemical composition of cement used by such large buyers as the Victorian Government railways can be obtained by interested manufacturers upon application to the Department of Trade and Commerce, Ottawa. The Victorian railways invited tenders, returnable in September, for 28,000 casks of cement. Local representation is absolutely necessary for this trade, owing to the short notice of tenders and on account of conditions of delivery. Canadian cement manufacturers, favorably situated for making shipment, should endeavor to obtain a portion of this business. Brands should be registered, and prompt measures taken for the submission of samples to the principal Australian importing centres to ensure Canadian cement being tested and placed upon "the list of manufacturers" acceptable to the various government departments and other large users.

* * *

Wire netting varying in mesh from ⅛ inch to 4 inches, and made of wire from 22 to 16 gauge, is a feature of Australian trade. Much of this netting is for rabbit-proof fencing. The sizes of the rabbit-proof netting in chief demand are:—

Width	Mesh	Gauge	Length
36 inches	1¼ inches	18 and 17	100 yards
42 "	1¼ "	18 17	100 "
36 "	1½ "	18 17	100 "
42 "	1½ "	18 17	100 "
36 "	1⅝ "	18 17	100 "
42 "	1⅝ "	18 17	100 "

Probably the best selling lines are 42 in. x 18 and 17 gauge, and 42 in. x 1½ in. x 1 8and 17 gauge. Rabbit-proof netting is also manufactured in Australia, and if the finished netting for export is not attractive to Canadian manufacturers there is also a market for the wire required by makers of netting within the Commonwealth.



Map of Greater Winnipeg Water District, showing route of pipe line, etc.

The Greater Winnipeg Water Supply from Shoal Lake

Specially contributed by D. McLean

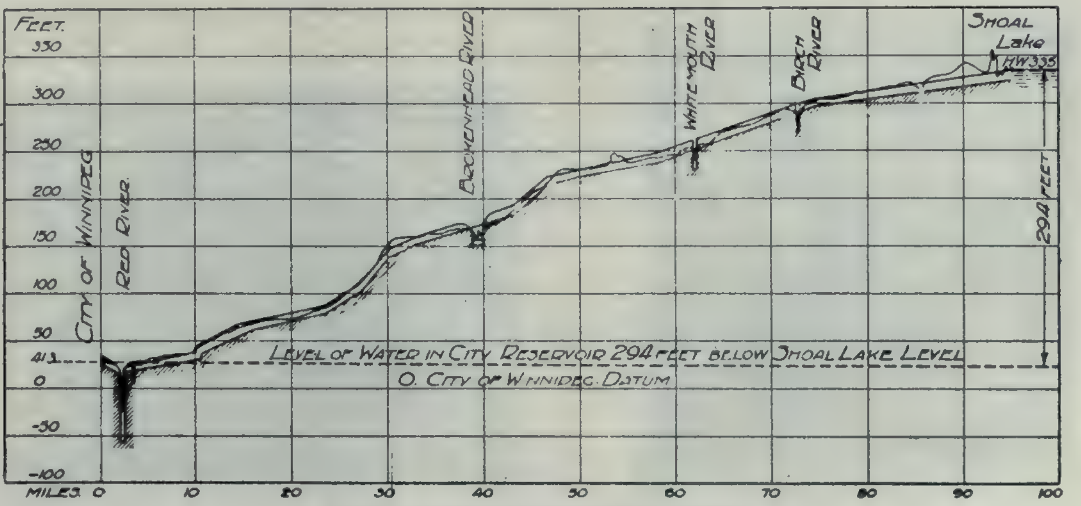
THE Greater Winnipeg Water District, comprising the city of Winnipeg, the city of St. Boniface, and all or portions of five other municipalities surrounding the city of Winnipeg, was created by Act of the Legislative Assembly of Manitoba assented to on February 15th, 1914. Clause No. 5 of this Act states "The objects of the Corporation shall be the supplying of water from any permanent source, whether within or without the province, for the use of the inhabitants of the said District, for all purposes."

Under the powers granted by the Act, the District chose Shoal Lake, a portion of the watershed of the Lake of the Woods, as its source of supply. In order to take advantage of the gross difference in elevation between Shoal Lake and Winnipeg (294 feet), it was decided to construct a gravity system of supply. On October 1st, 1913, a by-law was passed authorizing the expenditure of $13,500,000 for the supply of 85,000,000 Imperial gallons daily.

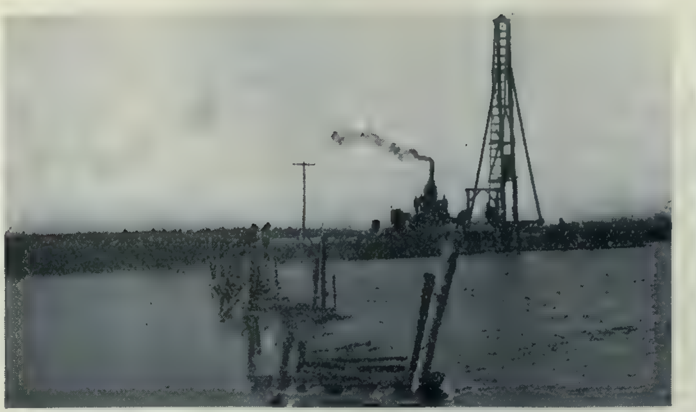
The main engineering features of the system, which is some 97.2 miles in length, comprise:—(1) a construction railway with 102.4 miles of track, including nine sidings, spurs to gravel pits and yards; (2) a dyke and channel at Indian Bay for the diversion of the Falcon River into Snowshoe Bay; (3) a concrete cut-and-cover aqueduct and works, eighty-five miles in length from the intake, Indian Bay, to a future reservoir site southeast of Transcona; (4) 9.8 miles of 60-in. steel pipe between this reservoir site and the Red River; (5) a tunnel under the Red River; (6) 2.3 miles of forty-eight inch cast iron pipe between the Red River and McPhillip's Street Reservoir.

In order to carry forward this work the following appointments were made after the passing of the by-law: Mr. S. H. Reynolds, C.E., Chairman of Commissioners; Mr. J. H. Ashdown, Commissioner (without remuneration); Mr. James H. Fuertes, Consulting Engineer, and Mr. W. G. Chace, Chief Engineer.

Five survey parties were speedily placed in the field for the location of the aqueduct line and a large office staff was organized for the necessary work on design. The location survey work, which was pushed to completion by the end of February, 1914, included



Profile of aqueduct from Shoal Lake to Winnipeg.



Construction railway—Brokenhead River Bridge.

Falcon River dyke, about half completed. Looking from scow to north shore.

some 380 square miles of topography, 362 miles of transit lines, 1,317 miles of levels, 95 miles of precise levels, 11,545 feet of soundings at Indian Bay and 3,897 feet of test boring along the line, with 7,445 feet at Indian Bay.

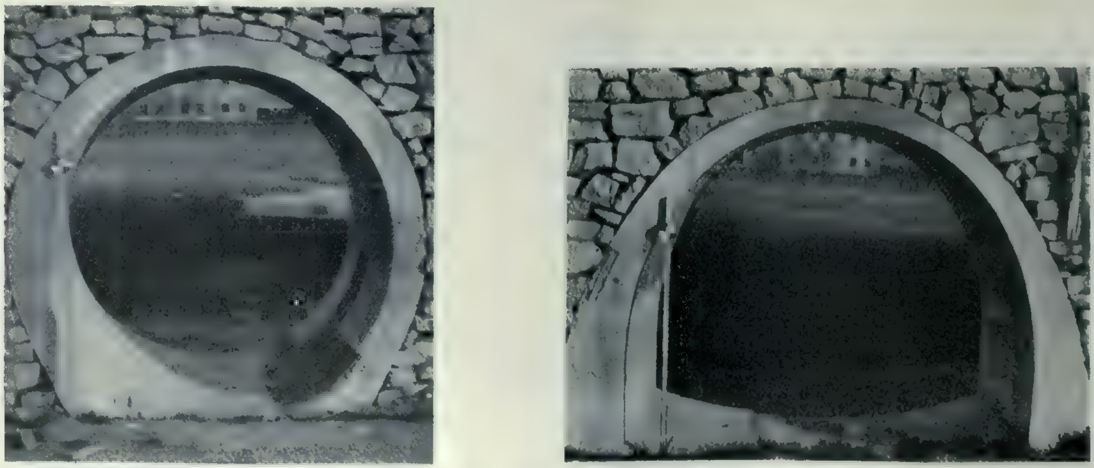
Construction Railway.—The located line of the aqueduct runs south of the Canadian Pacific and National Transcontinental Railways and north of the Canadian Northern Port Arthur line, through an undeveloped section of the country. In order to bring in the supplies and machinery required for the aqueduct construction, it was necessary to build a railroad along the aqueduct right-of-way. This road, which is now in process of construction, is of standard gauge, with 60-lb. rails and substantial road bed. Including yards, spurs to gravel pits and sidings, there will be in all about 102.4 miles of track. The maximum grade is 0.5 feet per 100 feet and the maximum curvature is four degrees. The aqueduct contractors' working tracks will be located between the railway and the trench. It will cost approximately $1,200,000 and it is being built by the Northern Construction Company, of Winnipeg. It will include in its construction the following materials:—9,671 gross tons of 60-lb. steel rails, 65,652 angle bars, 136,315 bolts, 1,158,560 spikes, and 284,580 ties.

The clearing of the right-of-way was done by E. J. Bawlf, of Winnipeg. This work cost $79,360.34 and comprised:—clearing, 2,586 acres; salvage, 7,900 cords of wood, 349,000 lineal feet poles, 14,467 fence posts.

A telephone line has been completed by the District from Winnipeg to Indian Bay. Residences have been erected for the engineers. Offtake drainage ditches have been dug. Roads have been built and other small works have been carried forward to prepare for the aqueduct construction.

Falcon River Diversion Dyke and Canal.—The water of the Falcon River, which drains about fifty square miles of muskeg area into Indian Bay, is dark-colored and requires some time to clear itself, through the natural agencies, wind and waves. To give the elements time to act on this water before it could possibly reach the intake, a dyke and canal are being provided to divert the Falcon River into Snowshoe Bay. Tomlinson and Fleming, who have the contract for this work, have nearly completed the dyke, which is some 7,500 feet long and contains some 250,000 yards. They have also finished the work on a temporary canal. The method of depositing the material in the dyke by use of dinky engines, four-yard Western side dump cars and scow, proved rapid and economical.

Concrete Aqueduct.—The aqueduct, 85.04 miles in length, has been designed for a minimum rated capacity of 85,000,000 Imperial gallons per day. It will be built of concrete and will be reinforced where under pressure or at other required points. The standard sections are arch or horseshoe-shaped for the gravity flow portions and circular for the parts of the line under pressure. There will be five depressed sections at river crossings, eight blow-offs and weirs, and two venturi meters. The average gradient is 0.62 per 1,000 feet, the lightest 0.11 feet per 1,000 feet, and the heavi-



Circular pressure section.

Arch section.

Test aqueduct sections.

Test aqueduct sections.

est 1.54 feet per 1,000 feet. The table at the bottom of the page gives the various gradients together with sizes of the aqueduct section.

Contracts for the construction of this aqueduct have been let to the following concerns:—

	Contract No.	Contract Section.	Station to Station.	Miles.	Amount.
J. H. Tremblay Company, Limited	30	Prairie	656 + 50 to 1718 + 00	20.15	$ 945,945
Thomas Kelly & Sons	31	Brokenhead	1718 + 00 to 2655 + 98	17.75	1,301,485
Northern Construction Company	32	Whitemouth	2655 + 98 to 3617 + 00	18.20	$1,268,680
and	33	Birch	3617 + 00 to 4466 + 50	16.10	1,137,010
Carter-Halls-Aldinger Company	34	Summit	4466 + 50 to 5148 + 60	13.00	1,489,520
		Total			$6,142,640

This work will include the following quantities of material:—

		Yards	
Top soil excavation		171,000	
Earth		1,988,000	
Rock		20,300	
			2,179,300
Foundation, embankment and refill			284,000
Concrete:			
Aqueduct		349,000	
Culverts, etc.		5,085	
			354,085
Lumber	M.F.B.M.		12,475
Reinforcing steel	lbs.		5,344,000
Cast iron and steel	lbs.		71,000
Cast iron pipes	lbs.		29,500
Cast iron gates			185,200
Cement (not included in the above contracts)	bbls.		500,000

The cement, sand and gravel will be furnished by the District. At present tests are being made relative to the best aggregate available from the various gravel pits owned and leased by the District, to be used for the concrete. This sand and gravel will be excavated from the District's gravel pits by means of a steam shovel and will be put through a screening and crushing plant, screened to several sizes and remixed, after which it will be hauled to the work by daily supply trains operated by the District or under contract.

Four seasons will be required to complete the work on the aqueduct contracts.

Prospective Contracts.—While the largest con-

Aqueduct Sections—Deacon to Indian Bay

From Sta.	To Sta.	Length in Feet	Length in Miles	Aqueduct Section	Slope in Feet per 1.000 Feet	Remarks
658 + 60	900 + 00	24,140	4.572	8′-0″ Diam.	.78	Contains Venturi Meter.
900 + 00	1234 + 00	33,400	6.326	8′-9″ x 7′-4⅝″	.30	
1234 + 00	1718 + 00	48,400	9.167	6′-4¾″ x 5′-4¾″	1.537	
1718 + 00	2080 + 00	36,200	6.856	8′-3¾″ x 7′-0″	.382	
2080 + 00	2220 + 00	14,000	2.651	7′-6″ Diam.	Depressed Section	Brokenhead River Crossing
2220 + 00	2655 + 98	43,598	8.257	7′-4″ x 6′-2¼″	.744	
2655 + 98	2955 + 98	30,000	5.682	7′-7½″ x 6′-5¼″	.60	
2955 + 98	3716 + 30	76,032	14.400	7′-5½″ x 6′-3½″	.684	Contains Depressed Section at Whitemouth River Crossing.
3716 + 30	3816 + 30	10,000	1.894	6′-7″ x 5′-6½″	1.29	
3816 + 30	4061 + 77	24,547	4.649	7′-11½″ x 6′-8½″	.48	Contains Depressed Section at Birch River Crossing.
4061 + 77	4592 + 60	53,083	10.054	8′-9″ x 7′-4⅝″	.30	Contains Depressed Section at Boggy River Crossings Nos. 1 and 2.
4592 + 60	4701 + 60	10,900	2.064	8′-10¼″ x 7′-5⅝″	.279	
4701 + 60	4812 + 60	11,100	2.102	10′-9″ x 9′-0″	.279	
4812 + 60	5150 + 10	33,750	6.392	10′-9″ x 9′-0″	.11	Contains Venturi Meter at Falcon River Crossing.
	Total Length	449,150	85.066			

tracts have been let on this work there still remains the following work for which tenders will be called in due time:—

Work	Estimated Cost in Consulting Engineer's Report.
Intake at Indian Bay	$ 50,000.00
60-in. steel pipe line from Transcona to Red River	896,400.00
Tunnel under Red River	129,900.00
48-in. cast iron pipe line from Red River to McPhillip's reservoir	278,200.00
	$1,354,500.00

In addition there will be equipment for the railway, gravel plant and other small items.

Financial arrangements have been made through the Bank of Montreal fiscal agents for the District by a Committee of the Water Board headed by Mayor Deacon. These will provide some $4,000,000 in all, the funds necessary for the work completed, the work in hand and that to be carried out next year. Arrangements have also been made with a view to the requirements of the succeeding years.

The first year closes on the Greater Winnipeg Water Supply with the work well up to schedule. During the period much has been accomplished. Permission to divert water from the Lake of the Woods, which ensures a plentiful supply, has been obtained from the International Joint Commission. A broad enumeration of the efforts put forth this year towards carrying this enterprise to a successful completion may be stated as follows: surveys; title to land for right-of-way, gravel pits, etc.; design of aqueduct structures; construction of railway; construction of dyke and canal; and last, but not least, the financing of the scheme.

Cost of Collecting, Hauling, Transferring and Transporting Refuse Materials*

By Samuel A. Greeley

ONE of the most important elements in the collection, haul, transfer and transportation of refuse materials is the cost. Many local factors enter into the cost element, and unless these are considered and understood, the cost data are misleading. Standard forms for recording cost data of refuse collection are not used extensively, so that the data presented should not be taken without qualification. In all cases, reference should be made—if possible—to the original source of the information. Methods of analyzing the cost of various parts of the service are given, followed by the actual cost data.

ELEMENTS OF COST

The elements of the cost of each part of the collection service can be studied advantageously by the following method. The unit quantities used in the computations were assumed for certain local conditions and will not necessarily apply everywhere. They are presented here to illustrate the method of analysis.

Loading.—The cost of loading will vary with the character of the material, the district served, the season of the year, the unit cost for labor in each locality and other local conditions. The method for loading garbage follows:—

(a) Number of people per house or per collection made ... 10
(b) Number of minutes required to make one collection or to give service to ten people ... 1
(c) Interval of days between collections ... 2
(d) Capacity of garbage wagons in tons ... 2
(e) Quantity of garbage produced in tons per 1,000 population per day ... 0.273
(f) Quantity of garbage after two days' interval between collections, tons per 1,000 population per day ... 0.546
(g) To make collections from 1,000 people requires 100 collections, taking 100 minutes' time ... ...
(h) Time in minutes required to load a wagon with two tons of garbage in accordance with the data above equals $\frac{2}{0.546} \times 100$ ... 367.
(i) The time required for loading is thus 6.1 hours.

If the cost of the team, wagon collector be taken at 75c per hour, the cost for loading one two-ton wagon will be $4.57 and the cost per ton for loading garbage ($2.28) ... 2.28

The analysis can be applied to the loading of ashes, rubbish, mixed refuse or any refuse material, if the proper unit quantities and basic data be first determined. The cost per ton for loading other refuse materials in accordance with assumed data will be as follows:—

Materials	Cost of Loading Per Ton
Ashes	$0.415
Rubbish	2.62
Mixed refuse	0.56

Motor Trucks.—The cost of loading a motor truck can be studied in a similar way. The cost of operation will be greater per hour and the rate of loading will have to be increased proportionately to make the cost compare with loading a team wagon. The cost of haul by motor truck will be less.

The use of motor trucks in refuse collection service will increase. A relatively high loading cost can be reduced by limiting the motor truck to transportation after the loading of the wagons by the so-called traction and trailer system now being tried on a large scale in New York City and used in quite a number of European cities.

Hauling.—The refuse material loaded in the collection wagon must be hauled to the transfer station or place for final disposal. This will be done by horse-drawn vehicle or by motor. The length of haul will be from the point of last collection to the place of final delivery. This distance or haul must be covered twice for each complete load.

The cost of haul will depend on the rate of travel, the weight of the load and the cost of the team and the driver, or motor and mechanic. The cost of team haul may be analyzed as follows:—

ASSUMED:

	Miles an Hour
Rate of travel	3.0
Cost of outfit	0.75
Cost per mile travel	0.25
Cost per mile haul	0.50
Cost per ton mile haul with a two-ton load	0.25

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*Paper read before the American Society of Municipal Improvements.

The cost of haul by gasoline or motor truck may be analyzed as follows:—

ASSUMED:

	Miles an Hour
Rate of travel	6.0
Cost of outfit	$2.40
Cost per mile travel	0.40
Cost per mile haul	0.80
Cost per ton-mile haul with a five-ton load	0.16

The rate of travel will vary considerably from different sections of a large city, being slower through streets congested with a large volume of traffic. In such districts collection work should be done at night or during the early morning hours.

Transfer Stations.—The operation of transfer stations should also be considered as a part of the cost of transportation. A transfer station to handle 600 cubic yards a day or 375 tons may cost, depending upon type of building and local conditions, about $50,000, including land in a fairly well-built-up section.

The annual cost of operation may be estimated as follows:—

Interest at 5 per cent.	$2500.00
Depreciation of plant	1250.00
Labor—	
1 Foreman	1200.00
4 Laborers	3600.00
Repairs and supplies	2500.00
Total	$10800.00

This is equivalent to a cost of 9.4c per ton.

The cost of transportation of refuse from the transfer station to the place of final disposal depends upon the method used. The cost for several methods is discussed below.

Trolley Transportation.—Assume a typical transfer station receiving 600 yards of refuse material a day. Assume trains to be made up of one motor car which carries no load and two trailers. Assume each trailer to have a capacity of 25 cu. yds. To move 600 cubic yards, 24 trailer loads are required. If the place of disposal be so located that each train can make two trips a day, six trains will be required. Assume that three motors can handle the six trains. The daily cost of operation will then be:

Motor cost, three at	$25.00 to $75.00 a day
Trailers, twelve at	6.00 to 72.00 a day
Total	147.00

If the 600 cu. yds. of refuse weighs 375 tons, the cost of trolley transportation will be 40c per ton.

Barge Transportation.—A good serviceable tug will cost about $30,000 and deck scows about $7,000 each. The annual cost of operating a fleet may be as follows:—

Annual Cost of Tug:		
Interest at 5 per cent.		$1500.00
Depreciation on 15-year life		1389.00
Labor:—		
Captain	$2100.00	
Engineer	1800.00	
Fireman	1000.00	
Deck hands	1800.00	
		$6700.00
Repairs		2500.00
Fuel		3500.00
Supplies		1000.00
Insurance		200.00
Total		$16789.00
Annual cost of Barge:		
Interest	$350.00	
Depreciation	324.00	
Deck-hands	1800.00	
	$2,474.00	
Assume that 1 tug serves 4 barges		$9896.00
Total annual cost of fleet		$26,685.00

If each barge makes one trip a day, carrying 100 tons of refuse, the cost per ton amounts to 22c. In like manner the elements of cost can be determined for other methods of transportation.

Steam Railroad Transportation.—The cost of transportation by steam railroads depends principally upon the switching charge. These will range from $5 to $15 a car. A car will hold about 40 tons of gar-

Cost of Collection (Loading and Team Haul)

For Refuse Materials—1914

S. A. G.

City	Year	Population served	Total Annual cost	Total Anl. Tonnage	Total Anl. Yardage	Unit Cost Per Ton	Unit Cost Per Yard	Cost Per Capita	Reference
Garbage									
Boston	1913	480,000	$131,648.40	54,215		$2.43		$0.27	Annual Report.
Chicago	1912	2,300,000	381,174.00	119,159		3.20		0.17	Civil Service Commission
Cleveland	1912	596,400	127,800.24	43,555		2.93		0.21	Annual Report.
Columbus	1912	192,700	34,779.23	18,789		1.85		0.18	Annual Report.
Dayton	1908	110,300	21,000.00	9,941	13,479	2.11	1.56	0.19	
Detroit	1910	465,766	66,865.67	34,065		1.96		0.15	Annual Report.
Evanston	1910	24,978	3,186.00	2,800	4,670	1.14	0.68	0.13	Annual Report.
New York	1910	4,406,000	275,380.00	336,984		0.82		0.06	
Winnipeg	1911	151,918	19,371.90	15,510		1.25		0.13	Annual Report.
Ashes									
Boston	1913	480,000	346,396.01	247,203		1.40		0.73	Annual Report.
Evanston	1910	24,978	2,174.00		13,461		0.16	0.09	Annual Report.
Winnipeg	1911	151,985	5,793.73	5,227		1.11		0.04	Annual Report.
Rubbish									
Columbus	1912	192,700	47,887.12		75,096		0.64	0.25	Annual Report.
Evanston	1910	24,978	5,108.00		29,479		0.17	0.21	Annual Report.
Ashes and Rubbish									
Cleveland	1909	543,000	119,982.00	84,547	202,752	1.42	0.59	0.22	Annual Report.
Cincinnati	1909	360,000	116,631.68	87,611	222,634	1.33	0.52	0.32	Annual Report.

bage, so that the switching charge will average about 20c per ton.

Available Collection Costs.—Actual cost data should be studied to check the costs estimated above, but these are not available for a large number of cities. The costs for collection service are generally recorded to include both loading and hauling in one figure, while costs of transportation are frequently given separately. The cost data for some cities in which the itemized cost of collection is available have been summarized in the following tables:

Chicago Data.—Jacobs & Senfield have made a careful analysis of the cost of collecting garbage and ashes, the rubbish in Chicago. This data is compiled in excellent detail and accuracy. The average costs for the five years—1908 to 1912—are given in table.

Average Cost of Refuse Collection

(Loading and Hauling)
Chicago, Ill.

Year	Cost Per Ton of Garbage	Cost Per Cu. Yd. Ashes and Rubbish
1908	$3.78	$0.56
1909	3.76	0.57
1910	3.43	0.59
1911	3.19	0.62
1912	3.20	0.60

If ashes and rubbish together weigh 1,000 lbs. per cu. yd. the cost of collection per ton amounts to $1.20.

IMPROVED METHODS FOR RECORDING COST DATA

The value of unit cost data for loading, hauling, transferring and transporting refuse materials should be realized by city officials. Accurate records should be kept and published in similar forms in different cities, so that comparisons can be made and a check secured on the efficiency of the local work. The total costs should be decided and recorded in accordance with the details discussed to show the cost of each element of the work.

Drainage Structures[*]

By W. E. Atkinson[†]

DRAINAGE structures, like many other features of highway construction, require the consideration of many factors in determining the type and character of construction adaptable to any particular location, or in determining a uniform standard or design to be used throughout any particular proposed highway project. Inasmuch as road construction together with drainage structures are more or less problems to be solved by every State or highway commission to meet local conditions, I shall not attempt to set forth any rules or plans governing the type or construction of all drainage structures, but merely present to you some of the general methods, factors and policies governing the construction of such drainage structures in Louisiana, under the supervision of its highway department.

In determining the length of bridges and spans between bents and piers and the size of culverts, consideration is given to the maximum rainfall, amount of run off, average slope of ground of drainage area, seepage, etc., as included in the same factors governing similar structures under railroad construction. After determining the required opening for waterway, the factor governing the required strength or carrying power of the structure is determined, so far as it is possible, upon the maximum load the structure is likely to be submitted during its bonded life. As to the bonded life of structures of this character, it is figured that they should last until bonds or taxes voted for the construction of same are retired, all structures being computed, however, to safely carry a minimum live load of not less than ten tons, plus 50 per cent. impact and a factor of safety of four.

It has been the policy of the highway commission of Louisiana to construct, wherever funds and conditions will permit, permanent structures and adopt uniform and standard plans for bridges and culverts for any particular highway project, however, oftentimes different designs are necessary to meet existing conditions, the type and design of bridges, whether they be of wood, concrete, or masonry, etc., are determined largely by the amount of funds available, and the character and nature of soil for foundation.

Due to the alluvial character of the soil, with the exception of some sections in the northern part of the State, there are instances where it is not safe nor economical to construct the arch type of concrete bridges; even with some of our girder and slab bridges, it oftentimes becomes necessary to provide pile foundations for the piers, abutments and wing walls. In some places it is necessary that these piles be of concrete instead of wood on account of many reclamation projects, now under way, lowering the ground water which would become detrimental to the latter type of construction.

We have found it advantageous and economical to provide, where conditions will permit, a uniform design for all drainage structures, especially for those of concrete construction, that the contractor may use the same drainage forms over and over, permitting thereby much lower bids per cubic yard on such work than otherwise under a system of non-uniform standard designs for such structures, and in addition, many times permitting without greater cost, greater waterway opening than theoretically computed, resulting in a larger factor of safety, and often providing for some unprecedented rainfall or cloudburst not anticipated. In addition to concrete bridges, the department is building many wooden bridges, both of creosoted and uncreosoted materials, this character of construction predominating in some parishes due to lack of funds for more permanent construction.

The department has installed several types of culverts, that of vitrified clay, cement, concrete, cast iron, wood, corrugated galvanized iron, etc., the type of construction being governed by the available funds and topographical features together with character of soil encountered in foundation, however, where practicable, concrete has always been recommended.

At many places, however, we have found it impracticable and not economical to use concrete culverts and others of a monolithic character, especially in some of the bayous and coulees. In one place in particular, it is recalled, where the foundation in one bayou was so poor that a strip 2 inches by 2 inches by 16 feet was pushed down its full length in the bottom of the bayou, and could have been pushed farther if the strip had been longer. This bayou was 250 feet wide across the top and 25 feet deep, and the only opening necessary was that of an equalizer with an area of some 28 square feet to be filled over with earth, thereby making a bridge of earth and of an equalizer. The equalizer installed at this particular location, was a ten gauge 6 feet diameter corrugated galvanized iron pipe culvert. The entire cost of this combination bridge, if it may be so termed, amounted to $2,059.27, including an item of $215.73 for riprap, whereas to have bridged the bayou with concrete, or to have attempted to build a concrete culvert, would have made the cost very much in excess of this amount. The only weak point I see, relative to this construction, is the more or less uncertainty as to the lasting qualities of the culvert from corrosion. This is stated merely to show some of the conditions that have to be met in Louisiana.

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[*] Paper read at Fourth American Road Congress.
[†] State Highway Engineer of Louisiana.

Due to debris, drift wood, and other extraneous matter, our highway department has adopted a policy not to install any culverts of less than 18 inches in diameter where possible, it preferring that they should be not less than 24 inches in diameter.

No doubt many of you will take issue with me on this point, but my experience has been that culverts of these sizes have proven more satisfactory and given better service, requiring less maintenance both for road and culvert at such places than when culverts are ample to carry the water, due to the ineffectiveness of the latter from drift choking and filling them up.

I have yet to find my first culvert that is too large for the amount of water and rainfall to be drained, but many have I found that were too small.

The Maintenance of Earth Roads*

By George W. Cooley†

We all know, either through our own experience or from the experience of other investigators, that the economic value of a highway depends to a great extent on its surfacing, and the care with which that surfacing is kept up. The nature of the material used for surfacing, its value as to hardness, toughness and its recementing quality is generally determined from the conditions of each individual case, but one factor remains forever the same, one rule must be continually in force, and that is a continuous and thorough system of repairs and maintenance. Without the careful carrying out of such a rule, the best of roads will deteriorate, the cost of transportation will become greater with each day's neglect, and our road will become a liability instead of an asset. By far the greater proportion of our roads, especially those in States having a large mileage and a moderate road fund, are the common ordinary earth roads either built entirely from the material at hand or covered when permissible, with a surfacing of gravel, sand, stone or clay, as necessities warrant, or conditions permit.

In the consideration of this subject, it is presumed that the fundamental principles of road construction have been followed, i.e., that an ample drainage system has been provided, and that the subgrade or foundation has been built up without the use of perishable material. Unless our road has been so primarily constructed, weak spots will develop when the drainage is imperfect or where sods or vegetable matter have been used in its construction, and the cost of proper maintenance will become excessive.

In the construction of a new earth road made in an open level or rolling country, the use of an elevating grader is quite common and under suitable conditions its use is justified by economy in construction work, but its value as a road builder is lessened if the two frequent result is obtained of casting the sods into the road bed, and depending on the regular traffic to thoroughly consolidate the mass so built up. This can be avoided by the use of a tractor in hauling the grader, which thoroughly pulverizes and packs the material cast in by the grader.

We may safely take it for granted then that in any road bed carelessly constructed with a large percentage of vegetable matter, the future bills for repairs and maintenance will be governed largely by the quality of unsuitable construction material used, and in case of a lax system of construction, a more elaborate system of maintenance must be adopted.

I quote the following from Mr. L. W. Page, director of the office of public roads:

> Overtopping all other road problems in its importance is that of maintenance. The destructive agencies of traffic and the elements are unceasing in their activities, and it is idle to talk of permanent roads any more than to speak of a house, a fence or railroad ties as permanent. The public roads today, by reason of the exceptionally obstructive traffic conditions, are more costly in construction and this cost is continually increasing with the advance in the prices of labor and material. It is criminally wasteful, therefore, to invest large sums of public money in building the highways demanded by traffic, unless the investment is conserved by adequate maintenance.

We conclude, therefore, that continuous maintenance being such an important factor in the general scheme, especial effort must be made to install a satisfactory and economical system as soon as a road is opened to travel. In some of our western States, the plan has been suggested of requiring contractors on surfaced roads to provide for maintenance as soon as any section is completed, and continue the same for at least thirty days after the work is accepted, thus giving time for the engineering department to provide for the organization of a maintenance crew without overlapping or interfering with the work of construction; and in Minnesota the plan has been adopted in the construction of earth roads to require the continual use of a drag or planer on grade building. This latter plan has been found very efficient and renders future work on the surface less expensive, besides tending to produce a more compact road bed. The tool found most satisfactory in this work is that known as the "Minnesota Road Planer" which consists of the two blades of an ordinary road drag, fixed between a pair of runners about 14 feet long, the blades set at an angle of about sixty degrees to the runner and made rigid or adjustable as may be deemed best. The planer is hauled on a line parallel with the axis of the road and its operation is similar to that of the ordinary drag, with the additional advantage of making a smoother surface. The old style drag without runners has a tendency, especially on new work, to increase the "waves" or undulations frequently occurring on road construction, while the planer eliminates these faults, and as a general maintenance tool has proven the most satisfactory.

An important feature of maintenance is prevention of the growth of sod and weeds along the travelled track. When sod is allowed to form along the highway, it has a tendency to catch the dust and wash from the road surface, and soon becomes a high tough shoulder, preventing drainage. The use of a spring tooth harrow along the roadside two or three times a year will prevent this growth.

The State of Minnesota has given special attention to the matter of maintenance and in the present road laws have made adequate provision for the care of all roads. Township and county roads constitute approximately 90 per cent. of the road mileage of the State, and of these roads, about 90 per cent. are earth roads. To care for the town and county roads, a one mill tax is levied on all property in the town and proceeds of which constitutes the town dragging fund. This fund is expended under the direction of an overseer, appointed by the town board, for the purchase of drags, and in dragging all roads of the town, excepting State roads. This appears to be the most satisfactory method of caring for the earth roads under control of the local authorities, but there should be a provision in such cases, for general supervision of the work by the county highway engineer.

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*Paper read at Fourth American Congress.

†State Highway Engineer of Minnesota.

For the care of State roads in Minnesota, 20 per cent. of the State road funds, with a due proportion of county funds, is set aside and may not be used for any other purpose than maintenance of State roads. As the State roads include all types of construction, different systems of maintenance have been required in the different localities. In general, three systems have been established: The patrol system on macadam and well built gravel roads, and the maintenance section system, and road drag system on other roads, all being under the direct supervision of the district highway engineer.

Under the patrol system, one man is assigned a section of from 5 to 7 miles of road and works with hand tools. It has been found necessary to supplement this work with the occasional use of a team and in that manner it has proven satisfactory on macadam and gravel roads.

Under the maintenance section system, one man is given charge of a section of from 20 to 30 miles of road and is employed continuously with his team on the care of his section. He is given authority to employ additional help, both teams and men, and usually has two teams and four or five men at work. Contracts are also entered into by the section foreman with residents along the road, for the dragging of same after each rain, or when ordered to do so by him. The section crew takes care of all minor items of construction, such as placing culverts, etc., and we have found that the work when properly done, is really of a constructive nature. This system is without doubt the most effective, and is being adopted generally throughout the State.

The dragging system requires the employment of a superintendent of maintenance, who for convenience should be one of the engineer's assistants, whose duty is to contract or make arrangements for the dragging of all roads under his charge, and to see that the work is done at proper times. This system is suitable for slightly undulating prairie country, where most of the roads are of earth, and to get best results, the superintendent should have at his disposal light graders to reshape the road bed at least at the beginning of each season.

On earth or gravel roads, no maintenance system is complete which does not contemplate the use of planers or similar devices, and a combination of work as outlined under the section system is recommended.

The Australian importations of black and galvanized wrought iron—or mild steel—butt welded tube constitute large figures. While Canadian tube is becoming favorably known throughout the Commonwealth, it is an anomaly that few malleable iron pipe fittings—black and galvanized—of Canadian make are imported into Australia. Illustrations of and quotations for large quantities of elbows (known here as bends) might lead to immediate business. All malleable iron pipe fiittings used in Australia are of the standard English Pipe Committee (Whitworth) thread —no others are saleable.

The Antiquity of Cement

EXAMINATION of Roman buildings constructed from 750 B.C. to about 300 A.D. appears to show that until the second century B.C., concrete was not employed by the ancient Romans. Before 100 B.C., some monumental structures containing concrete were erected, and from that time onward the material was increasingly used with considerable variation of composition and in exterior facing. On this point, Mr. E. B. Van Deman, in the American Journal of Archaeology, says: "In no period was concrete used to any extent without facing except in foundations and other invisible parts of buildings. Roughly at the beginning of the Christian era it reached the position of dominant material (or mode) of construction."

During the reign of Julius Caesar, concrete became quite common for foundation and the massive parts of masonry buildings, and some structures of this period are to be found consisting entirely of concrete faced with stone. In the time of Augustus, concrete construction became practically universal for foundation work, the massive parts of buildings and the core of walls. Besides using concrete in buildings, the Romans employed it for the construction of sewers, water mains, aqueducts and highways.

The dome of the Pantheon, erected 123 A.D., is the finest example of ancient concrete work extant. The dome is 142 ft. in diameter with an opening of 30 ft. diameter at the top, and has withstood the destructive influences of the weather for nearly 2,000 years without showing appreciable injury.

From the downfall of the Roman Empire to the latter part of the eighteenth century the manufacture of cement appears to have been discontinued. Modern Portland cement is undoubtedly far superior to the crude product of the ancient Romans, and it is consequently obvious that modern concrete should prove even more lasting than its prototype.

Tar-Macadam Work on Roads

DISTILLED tar should be used in order to procure a first-class material, especially where it is necessary to lay the tar-macadam a few days after the mixing, says a writer in the London "Surveyor." In cases where the material can be allowed to mature for a period of about eight or nine weeks, gasworks tar will give excellent results. Exposure to the air causes the light oils, etc., to evaporate; consequently, the setting properties of the macadam are vastly improved.

If it should be necessary to lay the material a few days after the mixing, a small proportion of lime added to the tar and stone during mixing will improve its setting properties. The lime generates heat, and therefore tends to drive off light oils, etc.

Roads in country districts are generally some considerable distance from railway stations, and it frequently happens that the material cannot be carted at a rate sufficient to enable the rollers to work full time. In these cases it is necessary to clump the tar-macadam on the road side so that it can be barrowed and spread when sufficient material has been accumulated to keep the rollers and gangs working at a reasonable pressure. Large clumps should be made, and the material in them kept as high as possible. Before commencing to remove the material, it is advisable to spray a small quantity of hot tar over the side of the clump next to the passing traffic.

The objection to small clumps is mainly due to dust raised by motor traffic adhering to the tar, and the amount of earthy material which would be shovelled up with the lower layers of the heaps.

Should it be necessary to scarify a surface prior to treating it with tar-macadam, the disturbed crust should be tightly steam-rolled before the new material is applied.

It has been found an advantage to water the old surface during hot weather before spreading the tar-macadam. Paradoxically, it is not advisable to sprinkle water on the roller wheels; a better job can be made by keeping them clear of tarry material by constant brushing with hard brooms.

The finished coating should be tar-painted and dusted with slag dust as soon as the material has worked to a smooth surface under the action of traffic. Under ordinary heavy traffic the tar should be lightly applied fourteen days after the completion of the rolling work.

It has been the practice to tar-paint tarred macadam every other year. The life of the material can be much prolonged by lightly painting soon after rolling, and every subsequent year.

Trade Enquiries

The Dominion Government Trade and Commerce reports contain the following trade enquiries. Readers of the "Contract Record" may obtain the names of enquirers by writing to the Department of Trade and Commerce and stating the number of the enquiry.

1097. **Wire Nails.**—A Manchester firm of nail manufacturers and importers wishes to get in touch with Canadian exporters of wire nails.

1098. **Screws.**—A Manchester firm of nail manufacturers and importers wishes to get in touch with Canadian exporters of screws.

1099. **Bolts and Nuts.**—A Manchester firm of nail manufacturers and importers wishes to get in touch with Canadian exporters of bolts and nuts.

1100. **Cold Rolled Hoop Iron.**—A Manchester firm of nail manufacturers and importers wishes to get in touch with Canadian exporters of cold rolled hoop iron.

1122. **Barbed Wire.**—A South African manufacturing firm is prepared to take up agency or purchase direct, barbed wire from Canada if quotations are satisfactory. Immediate correspondence requested.

1136. **Engineering Specialties.**—A London firm of engineers, claiming a good connection among contractors, builders and merchant houses, would be glad to hear from Canadian manufacturers of engineering specialties, tools, and articles associated with the building trades, who seek an export connection.

1153. **Boiler Tubes, Plates, Shafting, etc.**—A North Country firm would be glad to hear from Canadian manufacturers of boiler tubes for marine boilers, mild steel shell plates and furnace plates for marine boilers, and mild steel propeller shafts, tunnel shafting, and thrust shafts for marine engines, of which they seek supplies.

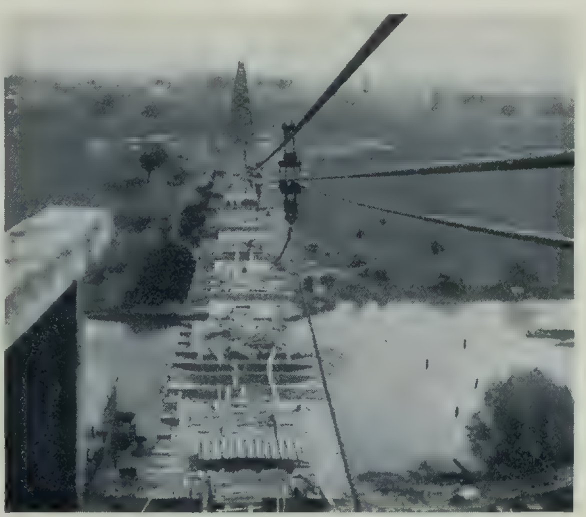
It is gratifying to learn from reliable sources that the arrival of cold weather has given an appreciable stimulus to business in the West. The general trend of reports received at the office of the Contract Record is that the farmers having finished fall operations money is being circulated more freely, individual debts are being reduced and mortgage payments are showing improvements. Collections continue to improve and the indications are that the next monthly returns will show an improvement over those of the corresponding month of last year. Conditions generally are encouraging, evidence of which is found in the fact that farmers in most districts are putting their crop money into circulation.

The Ontario Street High Level Bridge St. Catharines, Ont.

Contributed by Herbert L. Clark

THE Ontario Street High Level Bridge at St. Catharines, Ont., when completed, will connect the business district of the city with Glen Ridge, a new suburban development on the east bank of the Old Welland Canal. The Ontario Street Bridge, in design, was an approximate copy of a light (narrow gauge) railway in the south of England.

The bridge was to be of solid concrete masonry construction, twelve piers, 56 feet centre to centre, and thirteen arches of 50 feet clear span, with a rise of 20 feet, and roadway width of 20 feet on the arch and a 5-ft. cantilevered sidewalk on the north side.


Ontario Street Bridge, St. Catharines, under construction.

The city undertook to build the bridge by day labor and the work was started in the early part of 1913. By October all of the piers and four arch rings had been practically completed. At this time it was decided to increase the capacity of the bridge and to complete the work by contract. Accordingly Mr. N. S. Sprague, consulting engineer, of Pittsburgh, Pa., prepared plans, calling for a reinforced concrete bridge with a 26-foot roadway and a 6-foot sidewalk. Part of the roadway and the sidewalk was to be carried by cantilever brackets. Provision was made for interurban trolleys by a single track, close to the sidewalk.

The accompanying illustration, which is from a photo taken from the top of the west tower of the cableway, looking toward Glen Ridge, illustrates the cantilever brackets.

It is expected to have the bridge opened to traffic about this time. Frank L. Cohen, of Buffalo, N.Y., is the contractor and is represented on the work by Wright & Hazard, contracting engineers, of Buffalo. Mr. George Watson and the writer are acting for the city.

Uses of the Hydraulic Mining Cartridge[*]

Possibilities Which Have Received Inadequate Consideration—Methods Employed in Reservoir, Harbor and Foundation Work

By James Tonge

THE difficulty of removing rock and other material in places where the shock attendant upon blasting operations would be damaging and dangerous to surrounding strata or foundations is one which has not hitherto been thoroughly overcome.

The enormous initial power generated by the sudden decomposition of exposive substance has enabled great quantities of natural or artificial beds to be displaced, and a great portion of the work of the civil and mechanical engineer is involved either directly or indirectly in operations of this kind. The objection to the use of explosives, however, in many circumstances is that the effect of blasting can seldom be harnessed or controlled so as to prevent the disintegration of the material beyond the area which it is desired to dislodge. . . . . Pulverisation by explosives involves enormous waste of power, as it usually represents great excess of explosive charge; in other words, the use of explosives must involve either the risk of accident through an insufficient charge or the production of misapplied energy.

The hydraulic mining cartridge differs from all other mechanical substitutes for blasting. It is not worked on the principle of the wedge, and consequently the power expended in forcing a wedge into the hole is saved. Instead of employing a wedge, the disrupting effect is obtained by means of a number of small rams or presses working at right angles from a strong cylinder of steel. In order to make these rams more effective in their operation, by obtaining a greater travel from their original position, they are made of a duplex or telescopic form, one part sliding and fitting upon the other. In some cartridges these pistons operate from each side of the cylinder alternately, thus greatly increasing the travel. To retain the rams in position a sliding plate is used fitting in grooves in the barrel. This is so formed and secured that it is perfectly rigid and firm when the machine is in operation, but is readily removable if it is desired to detach or replace any of the rams. By a suitable arrangement of passages a communication is made between each of the rams, whereby simultaneous action is obtained. Machines are made of various diameters —viz., 2½ in., 3¼ in., and 4 in.—and of various lengths, say with 8, 6, or 5 rams, the smaller diameters having the larger number of rams. Pressures of 3, 4, or 5 tons per square inch are usual, so that machines are made to withstand great stresses.

The Pump.—The cartridge is operated by means of a pump, to which it is directly connected by a pipe. The pump is of special design. At the commencement of the supply of water it is desirable that the latter should be supplied in such quantities as to fill up quickly all the spaces within the rams and passages, while at the same time allowing the operator, when the rams begin to move and the pressure to increase, to supply a less quantity of water, but at a greater pressure, to complete the final operations of the rams.

In practice it is found possible so to arrange the hydraulic cartridge holes as to enable much greater areas of material to be moved than could be done with a safe quantity of explosive, while in some cases the displacement has been greatly extended by the use of small-sized boreholes towards which the slowly developing line of least resistance can assert itself. In other words, the power exerted by the rams can be controlled, after a little experience, so that the full pressure can be usefully applied.

Use in Reservoirs, Docks, Harbours, and Canals

The operations in these places have all certain features in common which allow of their being classed together, and they may be divided into three classes.

(a) **In Open Trenches.**—The difficulty of removing rock from confined spaces where it is necessary that no shock or vibration should be transmitted to surrounding strata is a very vital one. The introduction of the hydraulic cartridge into this class of work will, it is hoped, help to solve this question. During the past few years it has been thoroughly tested under most varied conditions and in all classes of deposits.

The work in trenches usually proceeds as follows: A number of holes are drilled, say, 2 ft. 3 in. back from the edge of the rock, about 5 ft. apart, and 3 ft. to 5 ft. deep, according to circumstances. The holes are, when possible, bored by a power drill operating from a tripod. By these means suitable holes, of diameters up to about 5 in., can be quickly drilled. The centre hole is pumped first and provides a loose end for those on each side. These are pumped in turn until the fast side is reached, where it may be found advisable to drill a small 1 in. diameter hole, say 9 in. from the fast side, to enable the cartridge to break the rock as close to the fast side as possible. Sometimes this method is varied by pumping off two centre holes simultaneously and placing the last holes 2 ft. from the fast side, leaving out the small diameter holes. In this case the holes could be 2 ft. 6 in. from the front edge, and two machines would be required.

Taking a trench 15 ft. in width and holes 3 ft. in depth, the first method would necessitate three cartridges and two 1-in. holes to get 100 cu. ft. of rock; while the second method would require only four cartridge holes to remove 112 cu. ft. During the operation of the machine it is possible to see the rock slowly fracturing at each turn of the handle. Work of this character has been done by the cartridge in connection with the Derwent Valley waterworks, and the Cwm Taff reservoir, Liverpool Corporation, and tests are now being made for the Abertillery water scheme.

(b) **Under Water.**—The appliance has been used in many cases under water, chiefly to remove rock, either from the sides of canals or from the sides of harbors and docks, where it was obviously impossible to use explosives, the machines being operated from the bank or from pontoons.

In the Alexandra Docks at Newport, and in the new dock at Swansea, the appliance has been used to break up ledges of rock occurring in the vicinity of walls which would have been damaged by the use of explosives. The holes were put in and the cartridges inserted under water by divers, and pressure was applied from the pump placed on a raft on the water.

(c) **Dock or Harbour Walls.**—Hydraulic machines have been used for some years at the Dover Harbour works for the purpose of detaching the large concrete blocks used in the harbour walls. These blocks are of great size and weight. By inserting the drill hole along the bottom of the block and placing the cartridge about half-way under it, the whole mass is slightly lifted and tilted without breaking, and being thus released from its bed is easily lifted on to a wagon by a crane. Machines are being used for a similar purpose in other docks.

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[*] From a paper read at a recent meeting of the Society of Engineers (Great Britain).

Excavation of Foundations

The question of the removal of concrete foundation beds by a method which would not involve explosive blasts and would avoid the slightest damage to machinery or buildings has been carefully studied recently by the writer, and had never been thoroughly solved until extended trials in all parts of the British Isles had been made.

The effect of powerful hydraulic pressure upon concrete is interesting. In the case of sandstone and shales there is comparatively slight crushing of the rock before the full pressure of the rams has the effect of causing the mass to bend; considerable pumping and consequent travel of the rams is then necessary before the rock finally begins to crack and break away. With concrete, however, there is usually a perceptible interval during which the rams are crushing or compressing the material, and no movement is noticeable; after this is accomplished a few more thrusts of the rams cause the whole mass to break up without any indications of bending. It may still be necessary to continue to apply pressure and to increase the size of the breaks in the mass, but the greatest shattering effect will have been accomplished at the first disclosure of the cracks, the pressure required to break the mass afterwards gradually diminishing.

In such material explosives invariably have the effect of "hacking a way through" by the shortest direction to the unsupported edge, pulverising the mass, but failing to take advantage of pressure gently applied, by means of breaks, which spread and widen, and to utilize the weight of the concrete itself to increase the scope of the operation. Numerous experiments in this class of work show that 60 to 70 cu. ft. of concrete can be easily removed per thrust.

The general procedure in attacking beds of concrete may be divided thus: (1) By vertical cartridge holes; (2) by horizontal cartridge holes.

(1) **By Vertical Cartridge Holes.**—This method is most applicable to places where power can be easily obtained to bore the holes by tripod and power drills. The cartridge holes are drilled about 3 ft. deep and 2 ft. 9 in. back from the front edge of the bed. It has been found of great advantage to drill small diameter holes 3 ft. away and in line, to which the fracture will break. In this way a bed 15 ft. wide could be broken all across by two cartridges and two small diameter holes, amounting to 124 cu. ft. of material.

(2) **By Horizontal Cartridge Holes.**—In this case the holes would be 3 ft. deep, and made to lift 3 ft. of material per thrust, the vertical small diameter holes being put in as before. The amount of material moved per thrust is 67 cu. ft. The effect of lifting up is to break a larger quantity of material and in much larger pieces than is the case with vertical holes. With the latter the concrete is found to be very well broken up and ready for handling without the further use of tools. Horizontal holes, on the other hand, are more suitable for beds where foundation bolts are embedded in the concrete.

There appears to be no class of work so suitable for this machine as the removal of concrete beds. The following recent case is a typical example. At a municipal electricity works the cartridge was used to remove the main engine-room foundation bed. Within a radius of 40 yards from the scene of operations, many of them within the same building, were very valuable Lancashire and water tube boilers, electrical and steam engines, and the main switchboard and cables. Needless to say, the work had to be carried out with as little vibration or shock as possible. Explosives were out of the question, and the ordinary method of hammer and wedge would have proved an extremely long, tedious, and expensive process. The bed consisted of a solid mass 14 ft. 6 in. wide, 26 ft. long, and 10 ft. deep, composed of hard cement concrete for the most part, and reinforced with numerous foundation bolts.

It was considered unnecessary to instal power drills on the work, and the holes in consequence were drilled by hand. The majority of these were horizontal, and were put in by means of an ordinary twist drill and ratchet machine by two men. These men could drill fairly easily 3 ft. per hour. One hydraulic cartridge only was employed. The general procedure was to keep the drillers at work putting in holes all round the side of the concrete, the machine following when two or more holes were ready. The holes were on an average 6 ft. 6 in. apart, and from 2 ft. 6 in. to 3 ft. below the surface in the case of horizontal holes. The vertical holes were drilled only in special places to trim down the vertical edge, and in these cases the measurements were about the same. The employment of shot holes to form a breaking point was considered unnecessary.

The debris thus broken was removed by a gang of six men, who were kept busily employed with pick and shovel, and wedges were necessary only to break up the larger pieces to a suitable size for handling. It was found that the amount of material broken up in the course of three or four shots was quite sufficient, in consequence of the limited and cramped working area, to keep the men busily employed for the rest of the day. Had it been possible to place more men on the bed there is no reason why a much better output should not have been attained, but in this case it would have been necessary to break open the wall in several places, which was not considered advisable. The whole bed, weighing approximately 200 tons of concrete, was removed in twenty working days. About sixty shots were necessary to complete the work, making an average of nearly 3½ tons per thrust.

The above cases will be sufficient to show that with a mechanical substitute for blasting capable of exerting a total pressure of 150 or 200 tons upon rock, coal, concrete, masonry, etc., and in such manner as to cause no shock to the material in which it is operated, there should be possibilities of usefulness to engineers not previously contemplated.

At Edmonton, exterior work is progressing favorably on the new armory which is being erected on the Hudson Bay Reserve at a cost of $286,000. The general contractors are Messrs. P. Lyall & Sons.

In Montreal, the value of the building permits issued from January 1 to October 31 this year totalled, roughly, $17,000,000, as compared with rather more than $21,000,000 for the corresponding period of last year.

The New Sewage Disposal Plant at Aberdeen, S.D.[*]

Details of Design, Construction, Operation and Cost, with Points of Practical Interest brought out in a Discussion of the System

PART I.

By W. G. Potter

ABERDEEN, South Dakota, is a town of about 12,000 population, and is located on flat prairie land, having very little fall in any direction. The city boundaries include about four square miles; the extreme variation in elevation does not exceed 15 ft. and that only in a very small portion of the city. No large streams flow within reach of the town for sewage outfall. The only stream at all available is a small, sluggish creek called Moccasin Creek, which flows through the eastern part of the city. Into this both the storm sewage and the sanitary sewage empty, and for the larger part of the year the only current in the stream is from this flow of sewage, increased by the waste and overflow from the artesian wells.

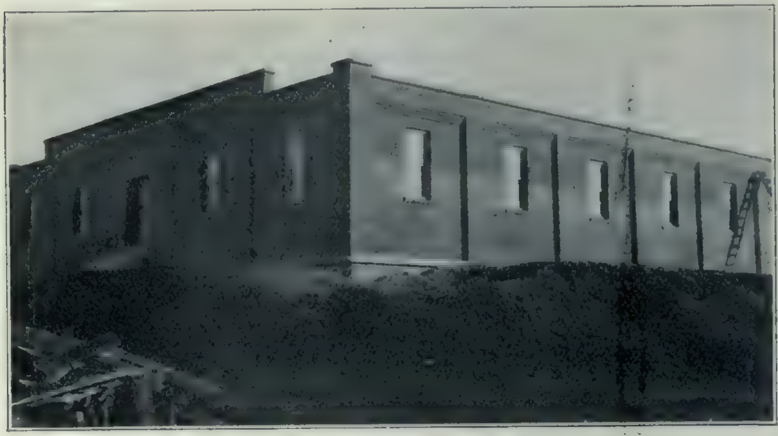

Fig. 1.—View of exterior of sedimentation tank.

Aberdeen, being in the artesian belt of South Dakota, derives all of its water, both for the municipal supply and for a large number of private supplies, from artesian wells. The pressure from these wells is very high, the static pressure amounting in some instances to as much as 240 lbs., while the hydrant pressure around town usually runs about 60 lbs., with a night pressure sometimes up to or over 100 lbs. One city well of 8 ins. diameter gave at first about 2,300 gallons per minute discharge from a depth of 1,270 ft. Many of these wells of smaller size are left flowing all the time, and because the storm sewer system is as yet very limited, this overflow goes into the sanitary sewers, thus greatly increasing the volume to be pumped and purified. Aside from this, the sanitary sewers contain very little except domestic sewage and the wastes from several laundries.

Old Disposal System.—The system in use heretofore has been as follows. All sewage has to be pumped. The pump station was located within a mile from the business district, and the sewage of the city is collected at this place in a 36-in. concrete sewer about 25 ft. deep. From this main the sewage entered three concrete wells inside the pump house, each 8 ft. in diameter, and each extending about 5 ft. below the 36-in. inlet pipe. In these wells were three centrifugal pumps, operated not continuously but with periods of rest lasting not over three hours, during which the sewage rose some 10 ft. or more in the wells and backed up in the main sewer correspondingly. The pumps were all submerged and hard to get at for repairs. They were operated by a vertical shaft and belted to a countershaft under the floor. The engine was a 55 h.p. Muenzel gas engine, deriving its power from one 60 h.p. and one 100 h.p. gas producers. With this engine, the sewage was lifted about 19 ft., run through a 16-in. force main about 1,000 ft., and then again lifted about 10 ft. into the septic tank. This tank was of concrete, partly with flat concrete roof and partly covered with a concrete block building. The windows and doors were all boarded up, and there was absolutely no ventilation, with the result that in places the concrete was entirely disintegrated by the sewage gases, leaving holes through the roof. There was no further purification, and the sewage entered the stream almost as foul as it entered the tank, this pollution continuing for a mile below the outlet of the stream, and emitting an odor that often reaches the residence district. Both the pump station and the septic tank were of poor concrete or concrete blocks, and as the former was in a dangerous condition, it was considered advisable to build an entirely new plant.

The new disposal system was planned to consist of a new pump house with larger pumping capacity, a force main to the new plant, a sedimentation tank, a sprinkling filter, sludge filter, and final settling tank.

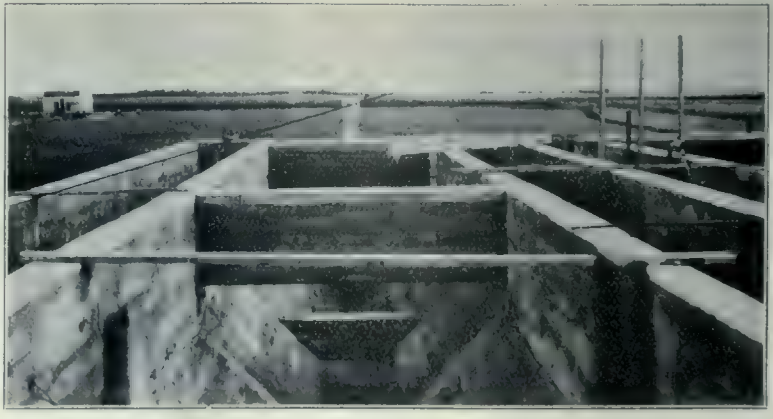

Fig. 2.—View of interior of sedimentation tank showing inclined sedimentation floors.

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[*] Paper presented before the Hydraulic, Sanitary and Municipal Section of the Western Society of Engineers.

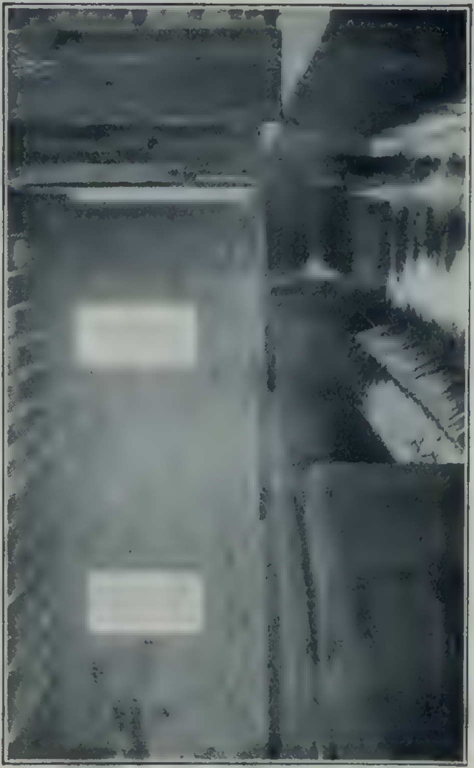


Fig. 3.—Interior of sedimentation tank in operation.

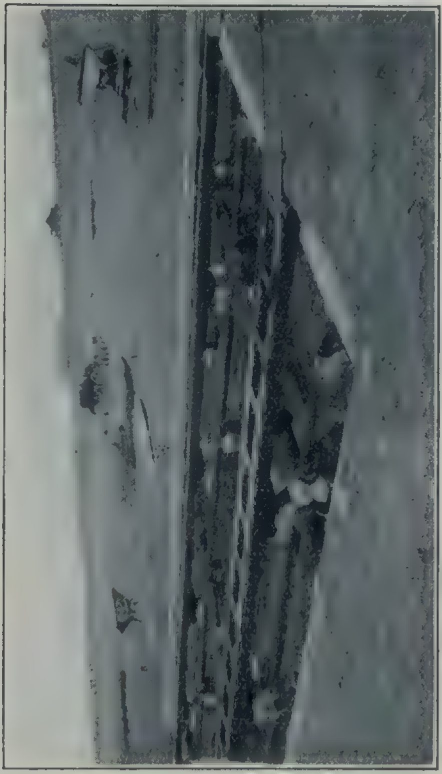


Fig. 4.—Sludge filter in operation.

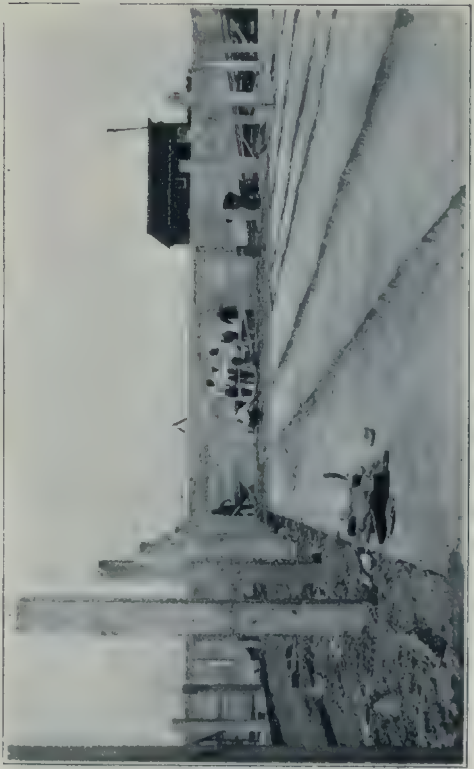


Fig. 5.—View of sprinkling filter showing drainage channels and roof supports.

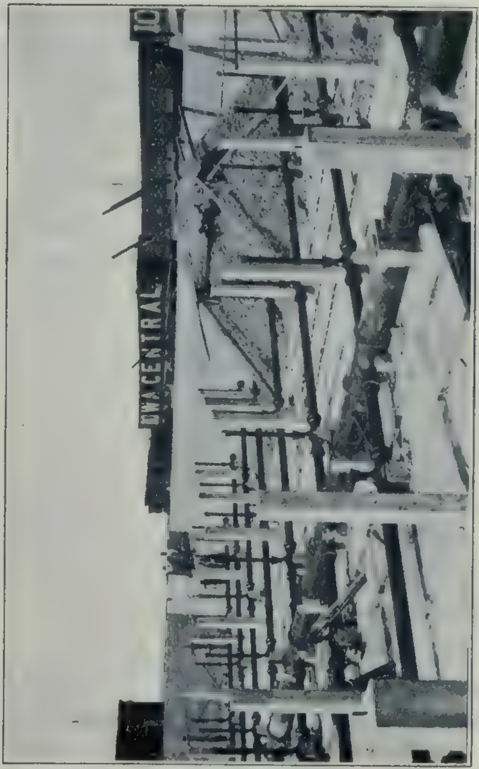
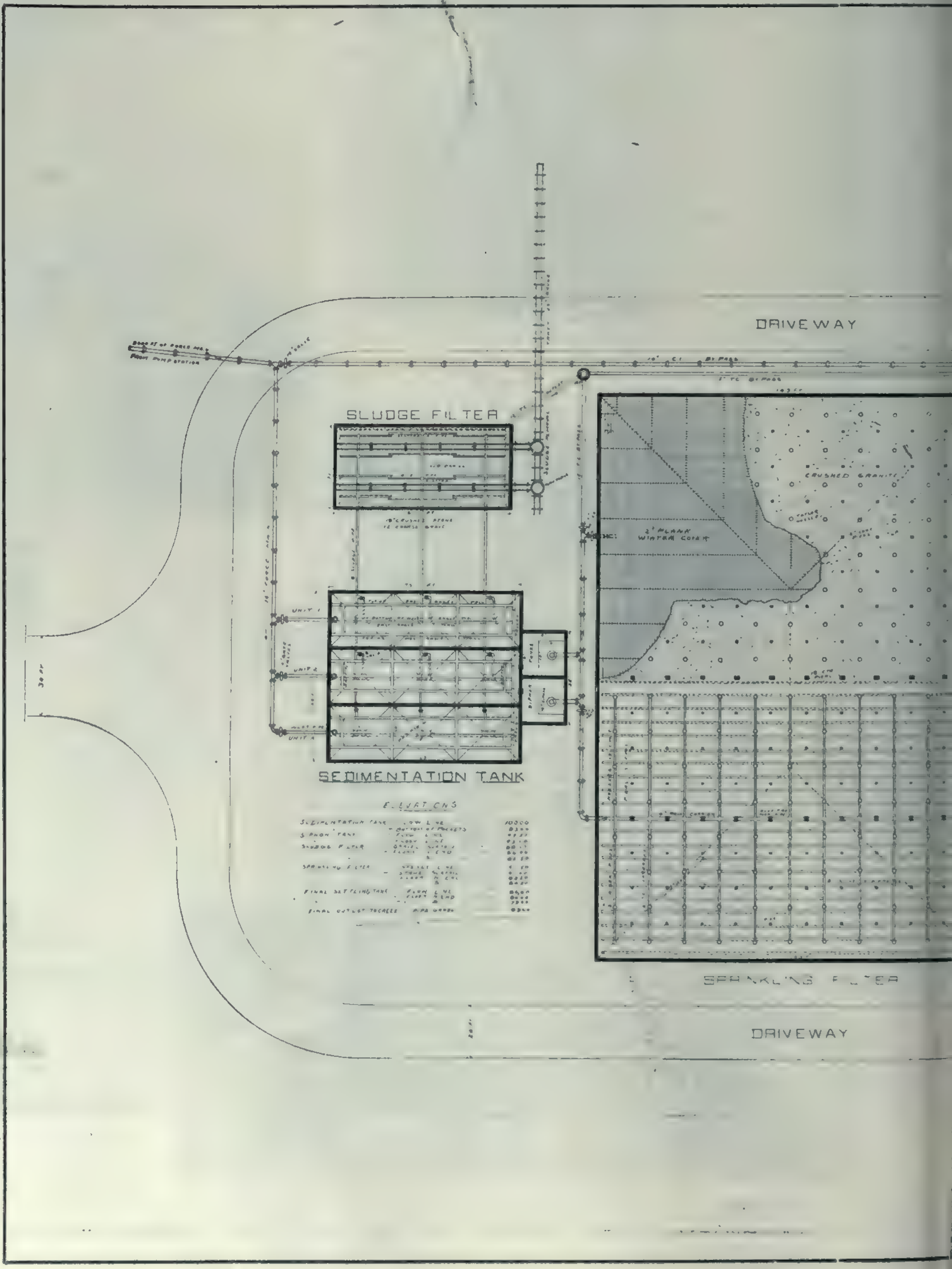


Fig. 6.—Sprinkling filter showing piping arrangement for sprinkler head.

The location decided upon was about two miles south of the town at the junction of Moccasin Creek with another small stream, Foote Creek, where some little additional flow would be obtained, at least in the spring and in wet seasons.

New Pump House.—Because of the concrete pump wells and the main sewer being in good condition, it was decided to locate the new pump house upon the site of the old one. The problem became to remove the old building, erect the new one, put in an additional engine and producer, put in three new pumps, and change the position of the old engine and producers, and still keep the pumps going with no shutdown of over the three-hour period. The first thing done was to remove the old building and erect the new one with the walls on new foundations just outside the old ones, thus making the new building slightly larger than the old one. This new building was made of brick with concrete roof on steel girders. Then the old pumps were removed one at a time, the wells were filled with concrete to the grade of the incoming sewer, and cast-iron inlet pipes and gates were concreted into the old terra cotta inlets. Connected with these inlet pipes are the three pumps—one 8-in. and two 10-in. Lawrence centrifugal pumps—so that all will be operated in the dry, and easily accessible for repair. Each pump has a vertical shaft running to a bevelled gear connection with a horizontal shaft above the floor. This horizontal shaft is built in three sections so that either pump may be operated independent of the other. By direct belts this horizontal shaft is connected to the old 55 h.p. and the new 100 h.p. engine. Both are of the Muenzel type of gas engine built by the Minneapolis Steel and Machinery Company. The horizontal shaft is also connected to a 30 h.p. motor for emergency, and this receives its power by wire from the Aberdeen Light & Power Company. In the producer room of the pump house the old producers have been changed in position and a new producer and wet scrubber added. Adjoining the producer room is a hopper-bottomed coal room, from which the coal is elevated to a point above the producers and distributed to each. Another room is equipped with a forge and small tools for repairing, cutting pipe, etc., for the city forces. A soft water well of 2-in. size, about 1,000 ft. deep, is now being bored to furnish water to the producers, as it is found that the hard water from the deeper wells has a corrosive effect on the steel pans. The reason for continuing the use of the producer gas engines was that this method has been very successful and very cheap for the old plant, and we did not wish to discard the old machinery. While I can give no accurate cost figures for the operation of the pumps, the cost has been within 1½c. per kw. hour against a 6c. rate from the light and power company for electricity. The pumpage for the new station will be continuous instead of periodical.

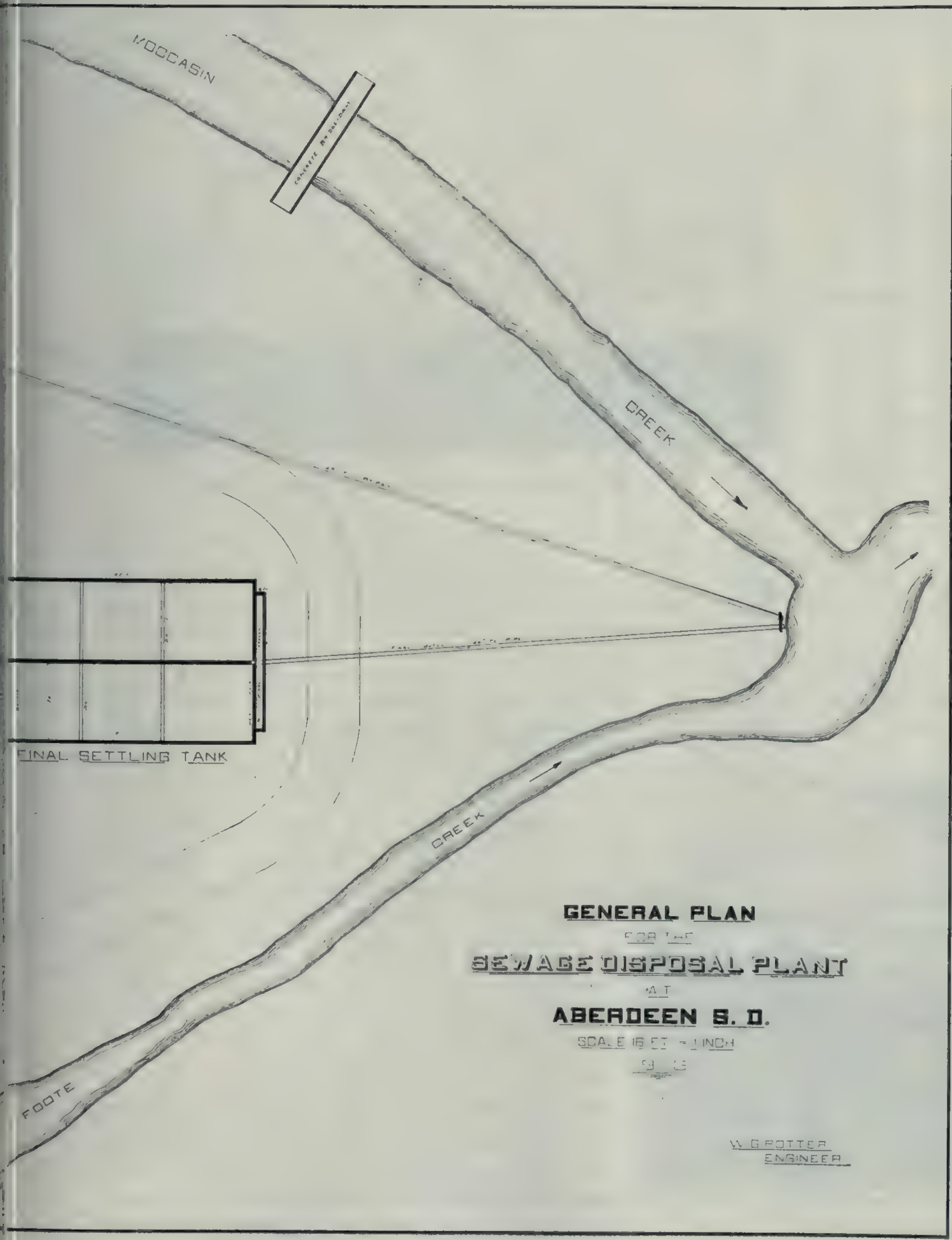
Force Main.—From the pump station the new system will utilize about 300 ft. of the old 16-in. force main, and will then connect to the plant with a new 14-in. main about 9,400 ft. long. The pumpage through this main will be normally about 1,500,000 gallons per day, which will give a barely self-cleansing velocity. It is considered that this pipe will carry the sewage without excessive friction until the discharge is about doubled, when another parallel pipe will be necessary. The force main is laid on a gravity grade from the pump station to the plant, with a by-pass at the plant,



so that in case of not being able to pump into the plant at any time they could either pump through the main to the stream or they could empty the main entirely by force of gravity.

Sedimentation Tank.—The sedimentation tank is rectangular in shape, 64 ft. by 73 ft. outside, and consists of three units, any one or all of which may be used at one time. Each unit has three pockets, 20 ft. by 23 ft. at the top and 2 ft. by 5 ft. at the bottom, in the shape of an inverted square pyramid. Suspended angle walls form the upper storey from which the sludge falls into the pockets. As the sewage is almost altogether domestic in quality, no grit chambers are used and the entrance of the sewage will be at one end of the tank only, through a 14-in. pipe in each unit from the force main, this pipe turning up inside the tank to a point about 6 ins. below the flow line. The depth of pockets and of sewage will be 17 ft. The flow line of the tank is about 10 ft. above the natural ground line. The outside walls of the tank are 15 ins. thick at the coping near the top and 24 ins. at the bottom, with piers extending well below the frost line at the corners and at the intersection of the unit walls with the pocket cross walls and outside walls. All are heavily reinforced. Above the coping of the outside walls the concrete is 3 ft. high and about 8 ins. thick, with a facing of brick outside. Above the concrete is a building of brick and hard-burned tile, for the purpose of keeping the sewage warm and accessible during the winter. This building covers both the sedimentation tank and siphon tanks, and has a roof of wood construction supported by posts on the unit walls and covered with Carey roofing. Ventilation is secured by means of doors, windows, and three ventilators in the roof. No waterproofing was necessary, except painting the inside surfaces with asphalt paint. Very few seeps were found on filling the sedimentation tank, and those were caused by water following the wires used in holding the forms together. All seeps were easily stopped by using a little pitch on the inside at these places. Each pocket has its sludge pipe and valve, 8 ins. in size, and the pipes from the corresponding pockets in the three units combine, forming three main sludge pipes which extend through the east wall of the sedimentation tank to the sludge filter.

The Sludge Filter.—The sludge filter is located 30 ft. east of and parallel to the sedimentation tank. It is 32 ft. by 67 ft. in size, uncovered, and built of plain concrete with 12-in. walls. It is laid with a 6-in. floor, in which are shaped concrete drains about 5 ft. apart. The walls of the filter come up to about the natural ground line, and the depth is 4½ ft. at the north end and 5 ft. at the south end. The filter material consists of about 18 ins. of crushed stone from 2 to 4 ins. in size, above which is 12 ins. of coarse gravel. The three mains from the sedimentation tank enter the filter just below the top of the wall on the west side, and each divides into a system of 4-in. cast-iron laterals supported on piers just above the surface of the gravel. Each of these laterals is slotted for nearly its full length and open at the end to facilitate cleaning. In operation, after receiving the charge from the sedimentation tank, the sludge is allowed to dry on the filter. The liquid filters down to the sub-drains, and is carried away through a 12-in. main to the filter by-pass, and runs through that around the outside of the sprinkling filter to the filter trough, thus getting the benefit of passing through the final settling tank. To facilitate re-



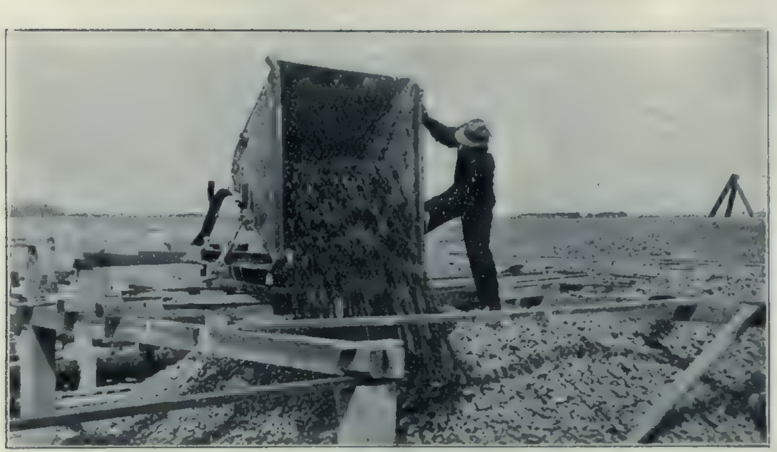


Fig. 7.—Sprinkling filter being filled with broken stone.

moval of the dried sludge, two tracks of 24-in. gauge, for industrial cars, are laid on concrete piers over the surface of the filter. The dried sludge will be spaded by hand into the cars and then removed to low ground and used for a filler.

Siphon Tanks.—The liquid, after passing through the sedimentation tank, passes over an 8 ft. weir in each unit, and into a trough, from which it goes through two 18-in. sluice gates into the two siphon tanks. These are adjoining the sedimentation tank, and are covered by the same building. They are each 16 ft. square at the top with three sides sloping, 10 ft. square at the bottom, and are fitted with a 14-in. Miller siphon of 5 ft. maximum discharge depth. Each one of the siphon tanks contains about 7,000 gallons when at discharge depth, and when running together each will discharge about once in fifteen minutes. Veeder trip counters will be used with float attachments to register the number of discharges of each siphon. The siphons discharge into a 14-in. main between siphon tanks and sprinkling filter, and branch 14-is. mains enter the filter in two places. By control of the gate valves, either siphon may be used for either half of the sprinkling filter, or all of it, and if necessary the discharge of the siphon may by-pass the filter altogether and come into the final settling tank.

Fig. 8.—Sprinkling filter completely filled with filtering material.

Sprinkling Filter.—The sprinkling filter is 143 ft. by 209 ft. inside, with plain concrete walls 8 ins. thick at the top and 16 ins. at the bottom. A 6-in. concrete floor is laid throughout, and in it about 4 ft. apart, are 8-in. terra cotta half tile sub-drains. Each sub-drain has a flat concrete cover, 18 ins. long, 10 ins. wide, and 1½ ins. thick, with two ribs which raise it 1½ ins. above the floor to allow the water to enter. These covers were designed and cast in Aberdeen and well seasoned before using. The filter floor has a fall to the south of 1 ft. in the width of 143 ft. On this floor crushed granite of 2-in. to 4-in. size was spread to a depth of 5½ ft. at the north end and 6½ ft. at the south side. One hundred and seventy-two carloads of rock were necessary to fill the filter to the required depth. The 14-in. main distributor enters the filter from the siphon tank in two places, each controlled by its gate valve. These mains run south through the filter on concrete piers about 1 ft. above the floor. Every 13 ft. on each main a 6-in. lateral extends east and west, and at each 13 ft. on each lateral is a 3-in. riser pipe, on which is a Taylor square nozzle. There are 88 of these nozzles on each main, or 176 altogether in the filter. Each lateral is laid on a grade to drain to its main, and each main drains to the south end. There each main has a 2-in. drain running to the filter trough, which may be opened by a stopcock, thus draining the entire distribution system if necessary at any time. On account of the usual extreme cold during the winter season, some precautions were necessary at any time. On account of the nozzles and filter. For this purpose, concrete piers were built midway of the nozzles, and 13 ft. apart in each direction. On these piers, rising above the surface of the stone about 6 ins., 4 by 4 posts were erected with 4 by 6 stringers, and on this framework a temporary winter cover of 2-in. plank is laid. The plank cover only will be removed during the warm season, the framework being left in place, although this framework is so built as to be removable without drawing a nail. This roof is of a flat hip roof construction with 3 ft. rise to the centre. All wood used on this was painted with a wood preservative before using. The sprinkling filter covers 0.68 of an acre, and with the present normal flow of about 1,500,000 gals. per day it will have a loading of about 2,200,000 gals. per day per acre.

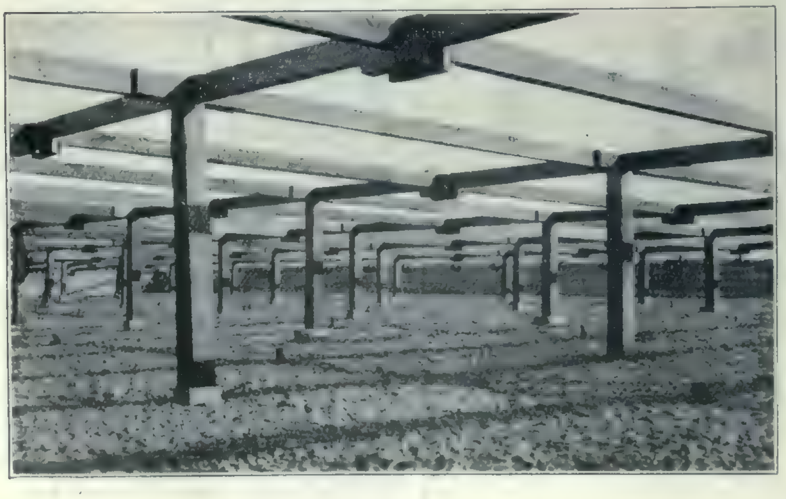
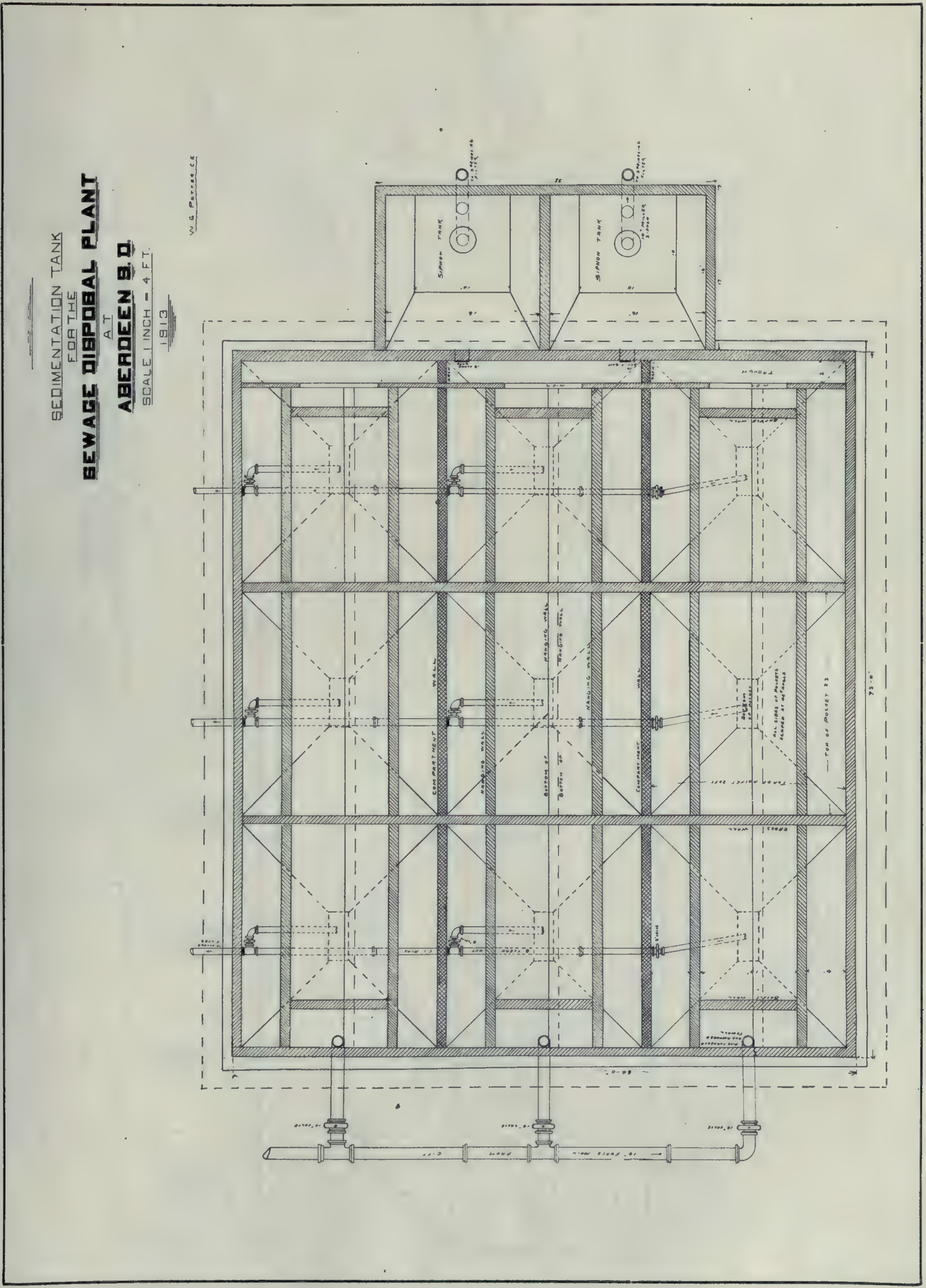


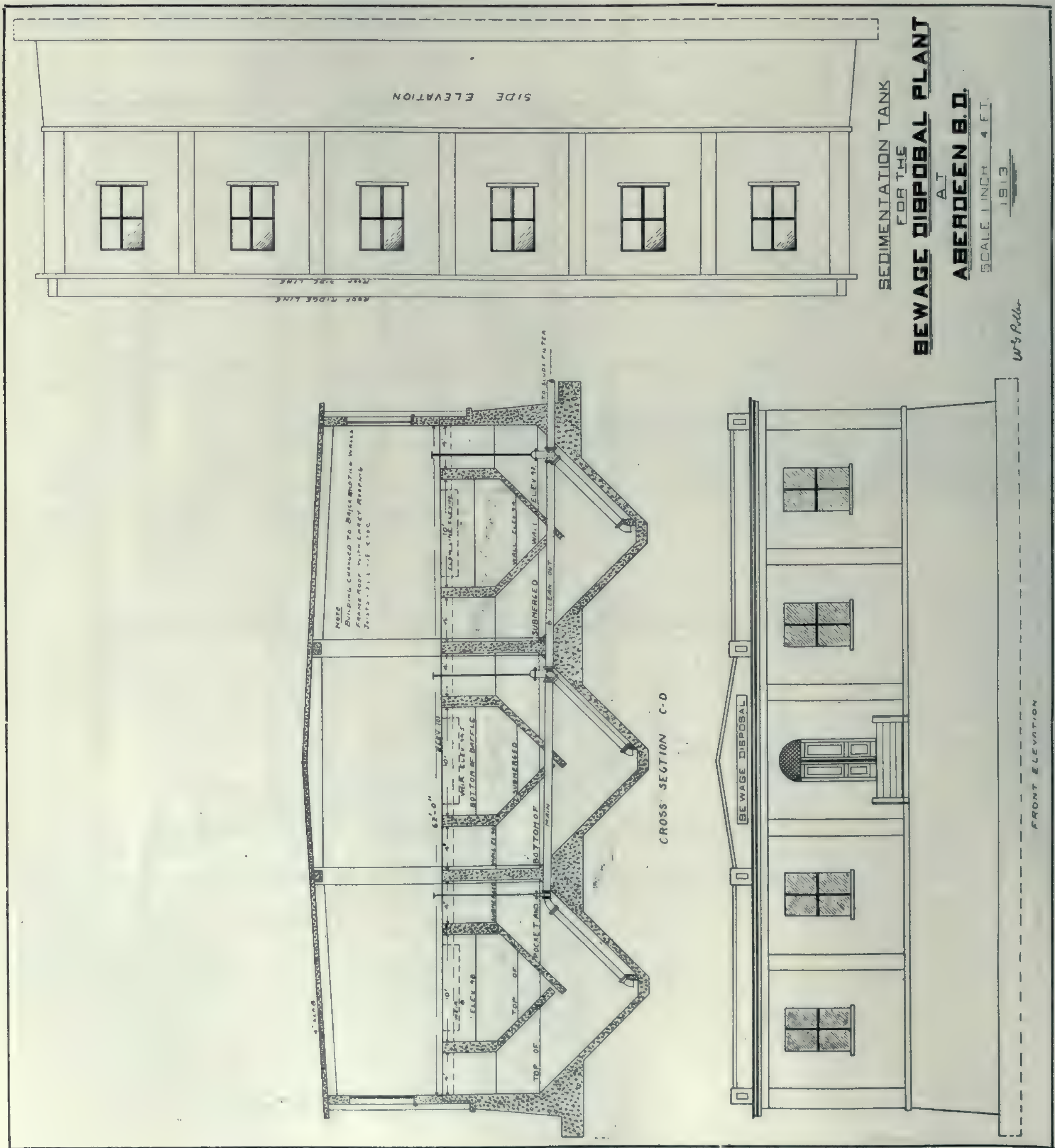
Fig. 9.—Sprinkling filter, showing roof structure.

Collecting Trough.—Running along the south side of the sprinkling filter, and separated from it by the filter wall only, is the collecting trough. It is 3 ft. wide, with a floor slightly below the filter floor; the outer wall is about 4 ft. lower than the filter wall and comes up only to the ground line. Arches are built in about 25 ft. apart over the trough to counteract earth pressure from the outside. All of the filter sub-drains pass through the filter wall and empty into this trough. At the east end of this trough also the filter by-pass mentioned above enters, carrying the water


SEDIMENTATION TANK
FOR THE
SEWAGE DISPOSAL PLANT
AT
ABERDEEN S.D.
SCALE 1 INCH = 4 FT.
1913
W. G. Potter C.E.
SIPHON TANK
SIPHON TANK
TROUGH
COMPARTMENT WALL
HANGING WALL
BOTTOM OF HANGING WALL
COMPARTMENT WALL
CROSS WALL
ALL SIDES OF POCKETS SLOPED AT 45°
TOP OF POCKET
64'-0"
73'-8"
10" FORCE MAIN C.I.

from the sludge filter and from the siphon tanks in case the filter should for any reason be put out of service. Likewise, the force main by-pass has a connection by which the entire plant above this point could be put out of service, if necessary, and still give the sewage the benefit of the final settling tank. This trough could also, in case of a typhoid epidemic or similar trouble, be used for a hypochlorite trough. After the liquid passes into this trough, it flows from either way to the centre and then through a covered trough to the final settling tank.

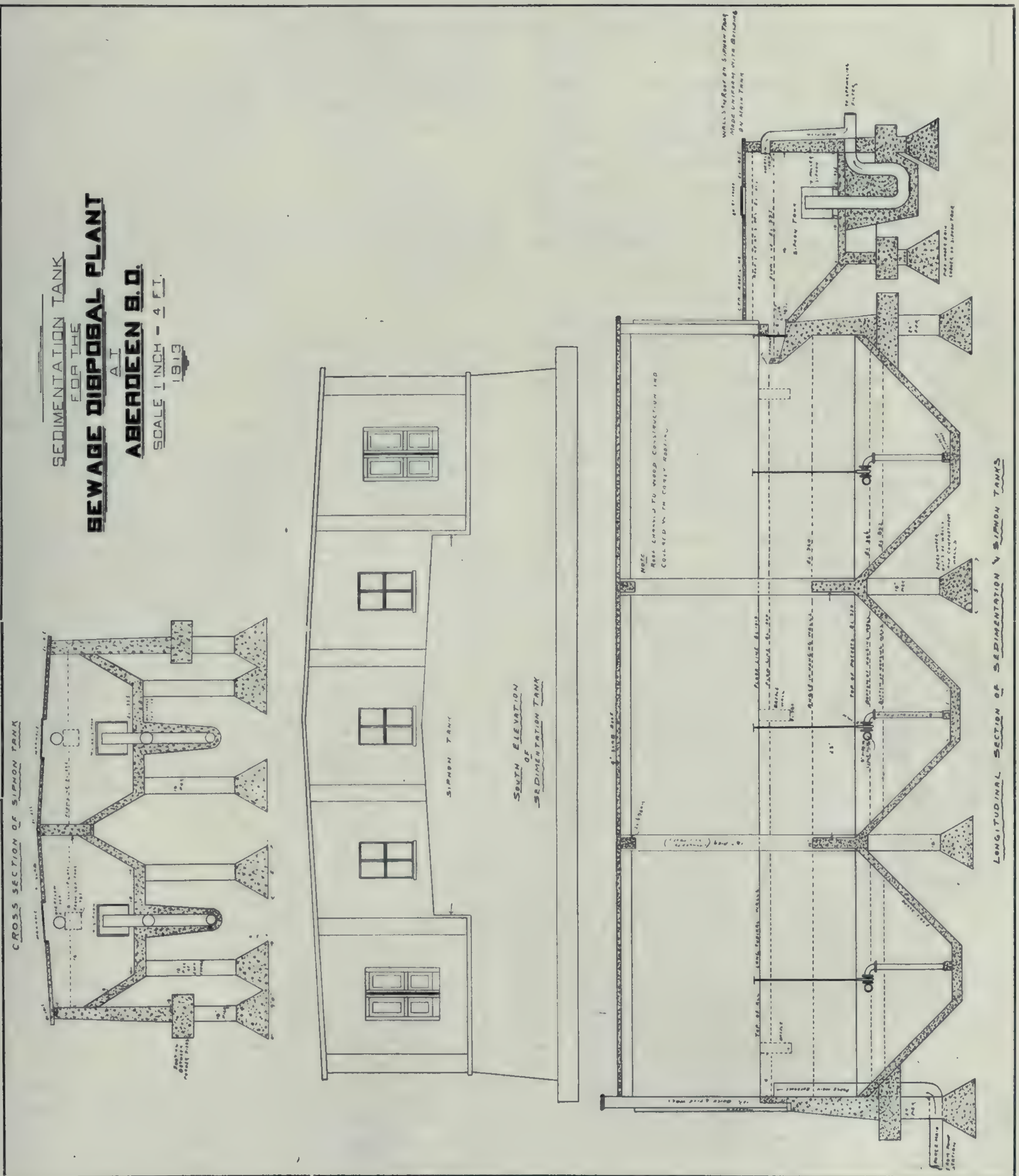
Final Settling Tank.—This is a plain concrete tank 63 by 103 ft. in size, divided into two parts by a middle longitudinal wall. From the collecting trough the flow enters a shallow, reinforced hanging trough, the flow into either half being controlled by a gate. From this trough it passes over a weir the entire width of the tank, to the tank proper. Here it passes slowly through under several reinforced baffle walls to the outlet end. The tank is about 4 ft. deep below the flow line, and it takes the normal flow about two hours to pass through, thus allowing the suspended solids a final chance to settle to the bottom. The floor of the final tank is below the outfall creek, and when either compartment is emptied for cleaning, it will have to be done by gasoline pumps. From the final tank the



effluent passes over two weirs in each half into a final trough, and from there through about 200 ft. of 20-in. terra cotta pipe to the final outfall into the stream.

Head Consumed Through Plant.—The elevation of the main sewer at the pump station is about 74. The sewage is pumped up to elevation 100 at the flow line of the sedimentation tank. The discharge of the siphon tanks is at about 99.5 and the elevation of the sprinkler sprays is 91.5. The floor of the sprinkling filter is 84.5 at the south end, the flow line of the final settling tank is 84.0, and the grade of the pipe at the final outlet is 83.2. This makes a total head consumed in the disposal plant of 16.8 ft.

Auxiliary Work.—Part of the auxiliary work connected with the proposition was the construction of two small reinforced dams across the two streams for the purpose of preventing the backing up of the effluent towards town in case of a south wind and no current. A 2-in. artesian well was also bored about 1,000 ft. deep to furnish water for construction and for other uses. A living house was moved from the site of Aberdeen's new City Hall, about three miles to the


SEDIMENTATION TANK
FOR THE
SEWAGE DISPOSAL PLANT
AT
ABERDEEN S.D.
SCALE 1 INCH - 4 FT.
1913
CROSS SECTION OF SIPHON TANK
SOUTH ELEVATION OF SEDIMENTATION TANK
SIPHON TANK
LONGITUDINAL SECTION OF SEDIMENTATION & SIPHON TANKS

disposal plant, set up on a concrete foundation and remodelled. It was connected with the well and given sewer connection, and is being used by the caretaker as a residence. About 1,800 ft. of railroad track was put in by the M. & St. L. Railroad to facilitate unloading material.

(Concluded in next issue)

Economics of Sewage Filters*

Sand, Contact and Sprinkling Filters—Population per Acre of Filter Practicable—Cost per Acre and per Capita—Economical Depth

THE output of a filter of any type depends upon the nature of the sewage, the nature and fineness or coarseness of the filtering material, the method of application of the sewage to the filtering material, temperature, atmospheric conditions and many other factors. The intermittent sand filter is best for obtaining a very high degree of purification; contact filters, sprinkling filters and others are used for a less degree of purification. By using a suitable rate under suitable conditions, however, any type of filter can be made to give any degree of organic purification that may be desired within the limitations of the type in question.

RATE OF FILTERING SETTLED SEWAGE

Sand Filters.—The question of the rate of application of the sewage to a sand filter is largely tied up with that of preliminary treatment by tanks or screens. The following table gives figures for each of several Massachusetts cities, showing the time of detention in sedimentation tanks, storage wells, pump wells or other kinds of storage, and the population whose sewage can be treated per acre of filter. The average of these shows that with 6.7 hours of detention previous to filtering, the sewage from 937 persons can be treated on one acre of filter. The Baltimore sewerage commission in 1906 estimated that sewage which had settled six hours could be treated on a sand filter containing 3 feet of clean sand at the rate of 1,200 people per acre.

	Period of Detention Hours	Population
Andover	1½–3	950
Brockton	12	1,160
Clinton	12	425
Framingham	12	375
Gardner (Old)	1½	1,310
Gardner (New)	1½	2,000
Pittsfield	12	605
Stockbridge	8	220
Worcester	1½	1,390
Average of all	6.7	937

Contact Filters.—American data for contact filters are relatively few, and the use of English data is rather dangerous owing to the difference in strength of English and American sewage. Experiments at Columbus, Ohio, indicated that contact filters containing 5 feet of stone could be safely operated at an average rate of 600,000 to 700,000 gallons per acre per day; or 500 gallons for a 4-foot depth, equivalent to about 5,000 people per acre. Tests at Lawrence, Mass., on beds of various depth gave an average of about 700,000 gallons per acre for a depth of 5½ feet, equivalent to about 135 gallons per acre of each foot of depth of stone, or again about 5,000 people per acre of 4-foot bed. Contact filters 4½ feet deep covering 3.6 acres at Plainfield, N.J., treated an average of 1.7 million gallons per day in 1910, equivalent to the sewage from 4,200 people per acre of 4-foot bed.

Sprinkling Filters.—For sprinkling filters much more satisfactory data can be had, and their ratings can be fixed with much more dependence. The depth and population per acre of several such filters are as follows: Reading, 5 feet, 18,000; Columbus, 5 feet, 18,000; Atlanta, 6 feet, 20,000; Philadelphia, 6 feet, 20,000; Montclair, 7½ feet, 15,000; Mt. Vernon, 8 feet, 24,000; Baltimore, 9 feet, 20,000; Fitchburg, 10 feet, 50,000. The average of all these is a 7-foot bed with 19,400 population per acre.

For ordinary conditions we may safely assume the following averages: Intermittent sand filters, 3-foot bed of sand, 1,000 per acre. Contact filters, 4-foot depth of stone, 5,000 per acre. Sprinkling filters, 7-foot depth of stone, 19,000 per acre.

COST OF SEWAGE FILTERS

Costs of construction are so much affected by local conditions, such as amount of excavation necessary, cost of materials and distance to be transported, etc., that comparative costs for different localities are to be used only with great discretion, and averages should be used only as a guide to comparative costs in various places. The average cost of the nine Massachusetts intermittent sand filters cited above was $3,260 per acre, or $3.50 per capita using the filters. The Baltimore sewerage commission estimated the cost per acre at $6,350, corresponding to $5.30 per capita.

The cost of contact filters equipped with suitable convenient appurtenances may be taken at about $30,000 per acre for a bed 4 feet deep, or $6 per capita.

For sprinkling filters 7 feet deep the cost will be about $45,000 per acre, or $2.37 per capita.

The relatively low cost of the Massachusetts sand filters, as compared with the Baltimore estimate, is due to the fact that conditions in that section of the country are unusually favorable for such filters. In most cases the costs would more nearly approximate the Baltimore estimate. It appears from this that the cost per capita of intermittent sand filters and contact filters do not differ greatly, and that sprinkling filters are a far more economical installation in the matter of first cost.

Depth of Filters.—The cost of filters will, of course, vary with the depth, but little is known about the relative advantages of shallow or deep filters. Very few tests have been made which give convincing information as to the most economical depth for securing a given degree of purification. In some places filters are made 10 feet, in others 6, and it is certainly worth while to determine which would be the better. In the following comparison it will be assumed that sufficient head is available for any depth adopted without adding to any pumping cost.

This question does not arise for intermittent sand filters, as these are not usually made more than 4 or 5 feet deep, and in general any amount over 3 feet is added merely to increase the number of times that the clogged sand surface can be removed before the entire reconstruction of the bed becomes necessary.

In the case of contact filters, where the amount of air drawn in between fillings is practically equal to the volume of the sewage and where surface clogging cannot be a serious factor, each cubic yard of stone forming the filter will give the same output of purification regardless of the depth of the filter. It would therefore appear that it is economical to build a contact filter as deep as local conditions of construction will permit, and the question of economy is therefore one of minimum total cost of constructing a containing basin for a given number of cubic yards of stone.

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* Abstract of a paper by George W. Fuller, before the American Society of Municipal Improvements.

For sprinkling filters the problem is more complicated. The Royal Commission reported that English practice seems to indicate that the output per unit of volume is the same regardless of the depth; but American experiments do not wholly corroborate this. Our best knowledge seems to indicate that the output per unit of volume is somewhat less for deep than for shallow filters. Therefore, with a relatively decreasing efficiency of the stone as the depth increases, and at the same time a relatively decreasing cost for construction per unit of volume of stone, there must be some point where the greatest output per unit cost of stone will be obtained. Baltimore Sewerage Commission in 1911 estimated, from tests made in Baltimore, that the relation between depth and results would be as follows:

	6 ft.	9 ft.	12 ft.
Relative stability	79	87	89
Per cent. reduction of oxygen consumed	56	70	72

Giving equal weight to the relative stability and per cent. reduction of oxygen consumed, we get the following:

	6 ft.	9 ft.	12 ft.
Relative stability	1	1.2	1.23
Per cent. reduction of oxygen consumed	1	1.25	1.28
Average of the two	1	1.22	1.25
Relative depths	1	1.33	2.00
Relative value of stone per cu. yd. ...	1	.92	.63

Assuming this depth varies at a uniform rate from one end of the curve to the other, we get the following for the relative value of stone per cubic yard:

	6 ft.	7 ft.	8 ft.	9 ft.	10 ft.	12 ft.
Relative value of stone per cubic yard	1.0	0.97	0.94	0.92	0.82	0.63

To get comparative figures then between the 6, 8 and 10-foot beds, the cost figures for the 8-foot beds must be divided by 0.94, and the cost for the 10-foot beds by 0.82, putting them all on the basis of the 6-foot beds.

For comparative costs a number of factors such as excavation, etc., are naturally omitted, as they are not affected in all places the same way by the depth of the filter. Comparing, then, only those particular costs which are affected per unit of output by the depth of the filter, we get the following:

	Cost per effective cu. yd. Depths.		
	6 ft.	7 ft.	8 ft.
Floor. Take at 0.40 per cubic yard for a 6-foot bed	$0.40	$0.35	$0.32
Tile. Take 11c. per square foot for any depth	.49	.44	.40
Walls. Assume cost 0.17 per cubic yard for 6-foot depth	.17	.17	.18
Galleries and Collectors. Assume for 6-foot depth 0.25 per cubic yard	.25	.22	.20
Distribution. Assume 0.50 per cubic yard for 6-foot depth; also, as costs theoretically vary only according to quantity delivered, they must be same for all effective depths per cu. yd.	.50	.50	.50
Stone. Assume $1.50 per cu. yd.	1.50	1.55	1.60
Total	$3.31	$3.23	$3.20

Outside factors will depend on quantity only and not on depth.

It appears then, that there is some slight saving of cost, which, on the figures given in the table, amounts to about 3 per cent. in favor of the 8-foot deep bed as compared with the 6-foot deep bed. On the other hand, it is to be recognized that a deep bed will give a good deal more trouble with pooling and freezing than a shallow bed, and the advantages in favor of a shallow bed due to this lesser amount of pooling will be considerably more than this 3 per cent. difference in cost. Taking everything into account, the writer believes that a sprinkling filter bed of not less than 6 feet and not more than 7 feet will, in the greater number of cases, prove the most economical to use.

The Canada Foundry Company's Toronto works received instructions last week to proceed with the manufacture of shells for the Government. Fourteen of the shells which were recently shipped as a sample to England proved very satisfactory in every way. They were tried in the guns with good results. The staff will work day and night in turning them out. The pump and brass departments have been increased. The other firms making these shells are Chapman Ball Bearing Company, Canadian Fairbanks Company and the John Inglis Company.

The Interior Construction Company, Limited, Winnipeg, state that they use several carloads of calcined magnesite and chloride of magnesia during the year and that from ten to twenty carloads are used in the city of Winnipeg. The company believe that there is a good opportunity for a firm to manufacture this production in Canada, as magnesite is found in its natural form in Quebec. The company state that they have to place an order for a 40,000-lb. car immediately, and up to the present have been unable to secure this material in Canada.

The Cheticamp Gypsum & Plastering Company, Limited, which holds a property three miles long at Cape Breton in Nova Scotia and which was organized about a year ago with a capital of $1,500,000, is putting into practice the theory of conducting business as usual. It has recently completed a new loading trestle over 600 ft. in length and has purchased a second locomotive to handle the output and facilitate shipments of the raw material to the United States. The company has followed up its opportunities so closely that instead of laying off men during the last few months it has increased its staff. To facilitate the building of its business the company has recently removed its headquarters to Montreal.

The Iron Age, commenting on the business situation, says: "The turning point has been rounded, and there is every prospect that the progress will be continued. It is almost inconceivable that anything could occur that would shock business and finance more than did the inception of this great war. The period of panic, of unreasoning fear, is passing, the real dangers are being faced and the problems are being solved. Complete confidence cannot be restored, and business cannot reach a stage of full normal activity in a period of weeks, or even of a few months, but the trends are now in the right direction. Having passed to a stage of greater inaction than current business and financial conditions required, the steel market is in line for a slight recovery, to put it in step with general business."

Faults of Engineers from the Contractor's Viewpoint

Interesting observations bearing upon the relationship of the engineer to the contractor are contained in a paper presented recently before the Albany Society of Civil Engineers, by Mr. Richard W. Sherman, Chief Engineer of the New York State Conservation Commission. The following extracts from this paper are given by our Chicago contemporary, Engineering and Contracting.

Contractors are largely influenced by their opinions of engineers. The engineer who has a reputation for ability, honesty, fairness and good disposition, will attract bidders for any work of which he has charge and the desire to do work under him would be an incentive to reasonably low prices. On the contrary, if contractors consider an engineer incompetent, dishonest, an inebriate or of a cranky disposition, they will often avoid bidding on the work of which he has charge or add to their bids a sum which they hope will cover the excess cost of the work due to the unfavorable attributes in the make-up of the engineer. It is a feature of contracting to "size up" the engineer with as much accuracy as possible, and many contractors become very expert thereat.

In bidding for work, contractors are almost as sensitive as weather vanes. As a rule, they run quite a risk of loss if they bid too low; and the engineer is at least one of the most important features in the situation, as by reason of the characteristics of the engineer it may be possible to make a profit at a given bid under one engineer and impossible to avoid a loss under some other engineer with all conditions, aside from the engineer himself, precisely similar.

Contractors who do not care for the contract often bid fairly high without any expectation of securing the contract, but merely to avoid a reputation among contractors of being low bidders and with the bare chance of getting the work at good prices. Excessively high bids are usually the result of lack of knowledge of the value of the work, lack of time to become familiar with it, and not infrequently from a variety of reasons by which the engineer has been "sized up" so unfavorably by some contractors that they do not want the work under him, are prejudiced against him and the work and consequently unintentionally or otherwise bid too high. The treatment which bidders think they will receive from the engineer if they secure the work is an important feature of the bidding.

If an engineer's preliminary estimate is believed to be too low it drives away bidders and tends to indifferent high bidding. Some over-anxious contractors may be influenced thereby to bid too low. They may secure the work, in which event the engineer has an unpleasant task during construction. There is almost sure to be a disposition on the part of the contractor to save himself from loss, and he is thus tempted to slight or cheat in the quality of the work which the engineer tries to prevent (as he should). The engineer, no matter how fair and just he may be to the contractor, will usually end with a feeling of enmity toward him. Both contractor and engineer are in some degree injured by the work having been done at less than cost. It is detrimental to an engineer to make a practice of making his preliminary estimates higher than the prices at which it is later found the work can be let to reliable parties. On the other hand, great annoyance and trouble and, in most cases, detrimental features which in one way and another causes loss to the owner and detriment to the reputation of the engineer result from making preliminary estimates too low.

In the matter of monthly and final estimates, contractors, particularly those ignorant of engineering, are very prone to suspect that engineers have under-estimated or cheated them. There never has been any good reason why contractors should not check up measurements and quantities even if it is necessary to employ contractors' engineers to do so. In large contracts this has been the custom for some years and is becoming more so. Many more engineers than formerly are engaged in contracting and this feature adds to the practice of contractors measuring and checking up estimates. It is to be hoped that this practice will become general.

Great injustice has been done engineers, as many intelligent contractors know, by the perpetual suspicion that the engineer is under of having cheated contractors. There is seldom a motive other than spite for an engineer to cheat a contractor and the spite cases I believe to be very rare. In small works, for instance, such as village water-works and sewers, some engineers may be tempted to under-estimate in order to keep the cost of the work down to the preliminary estimate or appropriations. I trust there are not many such, but I fear there are some.

An indolent, indifferent engineer and also a procrastinator, are torments to contractors and a cause of considerable unnecessary cost in executing the work.

Copper Alloy for Metal Lath Manufacture

Contributed by Clarence W. Noble

SINCE the first introduction of metal lath, architects and plasterers have known that it is very susceptible to the corrosive effect of hard wall plaster. At first this was not generally appreciated. For this reason many buildings have been erected in which the metal lath was entirely unprotected. The failure of certain early metal lath construction has brought the consequences of such careless specification to the attention of constructors, and as a result there has been given a greater amount of study to the protection of metal lath.

Besides the customary protection of metal lath by coatings there remains another method hitherto untried. This is by changing the composition of the metal itself so that hard wall plaster will have but little effect on it. Of course it would be highly desirable to make the lath of metal of such composition that corrosion would be impossible. This, however, cannot be done except at a prohibitive price. The next best alternative is to reduce the corrosion to such a degree that while the protective coating will still be used the attack at the scratch, should this occur, will have a negligible result.

For a number of months the writer has been experimenting along this line. He is now in a position to announce a specification for metal lath in hard wall plaster which will not increase the price of the material in the slightest and will reduce the corrosion at scratches to 1/15 of its former amount, a quantity which can safely be regarded as negligible. It was also found that this corrosion ceased under normal circumstances within a comparatively short time after the application of the plaster. This improvement will hereafter be adopted in the manufacture of Herringbone Metal Lath.

In the spring of 1913 the attention of the writer was called to the greatly increased resistance to corrosion that could be imparted to steel by the addition to its composition of a small percentage of copper. This alloy is now being manufactured commercially by the United States Steel Corporation. Roughly speaking it will resist the corrosive effect of dilute sulphuric acid about fifty times as long as ordinary steel. Its life when exposed to atmospheric influence is from fifty to seventy-five per cent. greater than the life of steel free from copper. When immersed in a solution of table salt it will last twenty times as long as ordinary steel. These facts led to the hope that in this material might be also found an increased resistance to corrosion arising from hard wall plaster. It was this hope that caused the writer to make his tests.

The tests here described were made by the Canadian Laboratories, Limited, of Toronto. They were supplied with a number of specimens of sheet metal, each one-inch square, both of plain steel and of copper alloy.

These were carefully cleaned of mill scale by pickling them in a weak acid bath. They were then washed with a solution of lime water, followed by pure water, after which they were carefully dried and weighed. After this they were placed in hard wall plaster and stored for the desired time of exposure. Five different brands of plaster were used. In order to secure a uniform result only enough plaster was mixed to bed one specimen at a time. The mixture was done with 40 per cent. by weight of water and the specimen was bedded immediately after mixing. The specimens were stored separately on glass plates and were kept in a saturated atmosphere. The reason for this is that the rate of corrosion is believed to depend to an extent on the amount of moisture that reaches the specimen. Comparable results can only be obtained when all specimens are treated alike, and only a saturated atmosphere can assuredly be kept at a constant humidity. These specimens were therefore kept over a water bath in an enclosed box.

When the time for the examination of the specimens arrived they were cleaned from plaster and washed in ammonium citrate. This chemical is a solvent for rust but makes no attack on steel. After cleaning, the specimens were carefully dried and weighed. The subtraction of the weight after hard wall plaster exposure from that found before exposure gave the loss by corrosion. From this the percentage of loss of original weight was thus readily determined. This percentage of loss instead of actual loss is the figure considered because thus the effect of any variation in the size of the specimen is eliminated.

Tests were made with five different kinds of commercial plaster, two different kinds of steel and five different times of exposure. Three individual tests were made with each combination of time of exposure, a brand of plaster and a kind of steel. Thus a total of seventy-five specimens each of ordinary steel and copper alloy were tested.

The plasters selected for tests are the five most widely-used plasters on the Canadian market. With one exception they are typical hard wall plasters. Their composition is mainly plaster of Paris. With this is a small amount of hair—a retardent to prevent too rapid setting—and, with all except number four, a varying percentage of lime. Plasters number two, three and five are about two-thirds sand. Plaster four was furnished neat, the intention being that the plasterer should mix his own sand. It was tested as furnished. Plaster number one is not properly speaking a hard wall plaster; while plaster of Paris enters into its composition it has about ten times as much retarder as the others and sets up much more slowly. It does not contain sand but in the place of it has a softer and more porous material, the evident intention being to increase its sound-proof qualities.

Although tests were made for five periods varying from one day to ninety days, the following table, made to show the varying effect of the different plasters, was made by averaging all times of exposure together.

Average Loss in Grammes by Corrosion with Different Plasters

Plaster	No. 1	No. 2	No. 3	No. 4	No. 5	Aver.
% Lime Content	3.88	6.92	2.00	0.00	1.00	
Plain Steel	2.63	0.47	0.79	1.99	1.66	1.51
Copper Alloy ...	1.43	0.13	0.61	1.66	0.87	0.94

Ratio of average results for each plaster tested

Alloy 1.00 Plain 1.77

Ratio for average for all specimens tested

Alloy 1.00 Plain 1.61

It will be noted that the various plasters differ widely in their corrosive properties. It is also a curious fact that the plasters showing lower rates of corrosion show relatively greater advantage for copper alloy. For example, number two plaster exhibits a rate of corrosion less than that of the others. The ratio of percentage of loss between copper alloy and plain steel in the case of number two plaster is as 1.00 is to 3.62. In the case of number four, the most corrosive hard wall plaster, the ratio is only 1.00 to 1.20. This explains why the average of the ratios by plasters does not check the ratio of the average of all specimens. The former figure is as 1.00 for copper alloy is to 1.77 plain steel, whereas the latter is 1.00 as compared with 1.61.

Plaster number one is apparently more corrosive than the others. On account of its slower rate of setting it holds moisture against the steel for a much longer time than do the other plasters. With this exception the varying rate of corrosion is due apparently to the varying proportion of hydrated lime in the composition of the plaster.

It will be noticed that with this exception, should the plasters be arranged in order of their lime content, they would also be arranged in the order of the vigor of their corrosive attack.

Unless a comparison is made between actual results shown by the different plasters, the full significance of this small varying percentage of hydrated lime is not appreciated. Omitting plaster number one we see that using plain steel, the rate of corrosion is reduced to less than one-quarter of its original amount by the addition of seven per cent. hydrated lime. If copper alloy is used, the addition of seven per cent. hydrated lime reduces the rate of corrosion to nearly one-seventh the original amount. If both copper alloy and hydrated lime are used the rate of the corrosion is less than one-fifteenth of what it would be if neither of these precautions was observed. Finally, as an extreme case, the rate of corrosion of number two plaster with copper alloy is only one-twentieth of the rate of number one plaster and plain steel . These results justify the statement that a specification has been found which will reduce the rate of corrosion at scratched places in the cold japanned protective coating to an insignificant amount.

Number three plaster is tested neat. The other plasters are about two-thirds sand. The fact that number three plaster falls into the place in the diagram that is indicated by its lime content shows that the presence or absence of sand has no effect on the rate of corrosion. If the walls were exposed to condensation from exhaust steam or other similar sources this might not prove to be the case.

Average Loss in Grammes for Different Times of Exposure

Time in days	1	7	14	30	90	Aver.
Plain Steel	0.13	1.24	1.47	1.85	2.74	1.51
Copper Alloy ...	0.07	0.72	0.81	1.52	1.60	0.94

It will be noticed here too that the effect of a decreased rate of corrosion is more apparent in the case of copper alloy that in plain steel. In the former case corrosion practically ceases at the end of thirty days. In plain steel, thirty-two per cent. of the corrosion exhibited at ninety days has taken place after thirty days.

These tests indicate the following conclusions:—(1) the addition of hydrated lime up to seven per cent. to hard wall plaster has a marked effect in reducing its corrosive effect on metal lath; (2) the addition of a small percentage of copper to the steel used in making metal lath is more efficient in enabling it to resist corrosion than the addition of fifty per cent. to the thickness of the metal; (3) the combination of seven per cent. hydrated lime with the copper alloy reduces the rate of corrosion to less than one-fifteenth of the rate shown when these precautions are not observed; (4) with metal lath formed from copper alloy corrosion from hard wall plaster ceases in about thirty days; (5) compared with these simple precautions the use of a heavy gauge as a means of resisting corrosion is exceedingly inefficient and expensive.

Concrete Roads—Their Design, Specifications and Present Status*

By A. A. Young

(Concluded from last issue)

It is a well-known fact that clay in the aggregate reduces the bonding strength, therefore if the resistance to wear and abrasion is to be high, the aggregate, both large and small must be very clean.

Another feature which points towards the specification of the rich mixtures is the comparative costs of the various mixtures to resist the same load, as is shown in table No. 6.

Table No. 6

1:1 :2	430	2.58	0.33	0.67	26.4	6.31	1.60
1:1½ :3	390	1.88	0.36	0.73	21.7	6.70	1.45
1:2 :4	350	1.48	0.38	0.77	19.7	7.13	1.40
1:2½ :5	300	1.22	0.39	0.79	18.3	7.87	1.44
1:3 :6	240	1.03	0.40	0.80	17.3	9.06	1.57

This table is worked out for a 350 barrel of cement, 30 per cent. voids in both sand and stone and costs are, $2.15 per barrel of cement delivered, $1.75 per cu. yd. sand delivered, $2.25 per cu. yd. stone delivered, and labor at $1.50 per cu. yd.

The column "cost per sq. yd. in $" shows that if we consider—as we should—the strength of the pavement to carry beam loads, there is nothing to be gained by using the lean mixtures. The 1:1½:3 mixture being of the same cost for the same strength as the others in table No. 6, has the advantage of resisting abrasion and wear as is shown in table No. 5.

Even if the rich mixtures are used, undue wear may take place, due to insufficient curing. When laid in such thin slabs, the concrete will dry out before it sets and its power to resist wear will be lost. If the concrete is kept damp for 14 to 21 days the surface will become very hard and also the whole slab will become considerably stronger than if it were left to set up without protection from the heat.

Having a rich mixture properly surfaced and cured we have then to consider the amount the pavement will wear. The tests in table No. 5 subjected every part of the surface to the passing of a heavy traffic wheel two thousand times. That is equivalent to the passing of two thousand heavy wheels in the same track. It would seem, therefore, that for the best mixture a wear of 1/10th to 1/16th of an inch per year in the centre of the road would be a safe allowance. At least one inch should then be added for wear.

2. Specifications

The points in the specifications which need special attention fall under these heads:—grading, drainage, mixing, surfacing, curing, inspection.

Grading

The usual points in a grading specification are:—1, no soft material or spots to be allowed; 2, all roots and sod to be removed; 3, all the filling to be rolled in layers not more than six inches thick.

These points are all important, especially the last, but the following points which are usually omitted, are of even more importance:—

1. That the roller shall roll as much and more on the outside edges of the subgrade as in the centre, the tendency being for the roller to work mostly up and down the central portion of the subgrade.

2. Subgrade to be built at least three feet wider on each side of the pavement at the time the main subgrade is built.

3. Where the pavement is laid upon the old roadbed which has been crowned, the old crown shall be broken up and worked over so as to have an even fill throughout the whole width of the pavement.

If these three points are not insisted upon the road will crack longitudinally.

Drainage

The specifications for drainage of country roads are different from those for cities and towns with sewerage systems.

1. Country roads.

The general drainage along a country road is carried inside ditches, while the edges of the pavement are protected from the surface water shed from the pavement by small trenches placed on each side of the pavement, which are filled with stone or gravel and which have outlets to the side ditches.

The important features are: 1, to have the main ditches on each side of the road deep enough to keep down the water level under the pavement; 2, to have these ditches drain quickly.

2. City and town streets.

1. Where curb and gutter are used on the outside edges of the pavement, the surface water is carried to catch basins and away.

2. The subgrade should be protected against moisture from the edges by putting a narrow trench at least two feet deep under the curb, filling it with a pervious material and draining it to the catch basins also.

The importance of these deep drains to reduce moisture may be realized from the fact that in cities where these drains are run to catch basins, water can be seen trickling in at any time during the summer months. The seepage water can only be kept down by deep drains and the surface water must be quickly disposed of.

Mixture

The outstanding features in mixing are: 1, the ingredients must be clean; 2, the proportions must be accurately measured; 3, the coarse aggregate shall have a predominance of the large sizes 1 to 1½ inches; 4, the materials shall have no soft or flat particles; 5, the fine aggregate shall be free from fine particles; not more than 10 per cent. to go through a 50-mesh sieve. The fine aggregate shall also be tested for tensile strength; 6, the aggregates must be separately measured; 7, the mixture should be 1:1½:3 or 1:2:3; 8, the amount of water should be enough to give a pasty and not a sloppy mass. (This prevents the separation of the coarse aggregate from the mortar in placing) 9, all the materials shall be at least 45 seconds in the mixer drum before any is discharged; 10, the subgrade shall be sprinkled just before the concrete is placed so it will not absorb moisture from the concrete; 11, enough labor shall be put on to work the concrete sufficiently after it is dumped to ensure an even distribution of the coarse aggregate in the mortar.

Surfacing.—Great care shall be taken in finishing that the surface be made even. The surface is usually struck off with a template the shape of the crown. This template is worked back and forward in a short saw motion across the road, and at the same time, along the road. This leaves small marks or ridges on the surface which are trowelled over with a wooden float. If the surfacing with the template is done two or three times, the trowelling will easily give an even surface. If the surface is uneven the traffic will have a tendency to pound and produce holes.

Curing.—As soon as the concrete has set enough as not to be disturbed, it should be sprinkled and covered with canvas or clay. This covering of clay is made two or three inches thick and is kept damp for the whole period of curing, which is 7 to 14 days. The longer it is sprinkled and cured, the harder will be the surface. The dampness also helps to equalize the contraction due to setting and reduces the initial stresses in the slabs.

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*Paper read before the Manitoba Branch of the Canadian Society of Civil Engineers.

Inspection.—The overlooking of any one of these main points of the specification in a concrete pavement will result in part failure of the road. The majority of these requirements appear in almost any specification for concrete and a great many of them are interpreted as of little importance. This is probably due to the fact that the concrete in almost all cases is only called upon to carry compression. It has been clearly demonstrated in this discussion that in road work, concrete is made to carry beam loads, and is therefore subject to tensile stresses so that its use for this purpose demands a far more rigid inspection and enforcement of the details of the specification.

The materials should all be examined as to sizes and enough tests should be made to be certain of their strength and of the absence of clay. This should be done before the materials have been distributed along the road. In fact, a much better method is to have a careful examination made of the source of supply and then more examination by eye at the cars to see that the material received is that which was passed at the source of supply.

The grading and rolling require rigid inspection, a thing which they very rarely receive. The requirement of rolling in 6-inch layers and rolling equally well at the sides and centre should be enforced, also the breaking up of the old road crowns.

Too much stress cannot be laid on the inspection and a paving contract of any magnitude should have at least: 1. One engineer competent to inspect materials and look after the grading, and, 2. An assistant inspector at every mixer working.

Some may consider that this would cause strained relations with the contractor. It need not if the contractor is made to realize at the time of bidding that all the details in the specification will be enforced. This is only fair to the contractor and although his price would be a little higher, it would result in the inspection department and the contractor working together to make as good a job as possible. After all it is very difficult to get more than we pay for and a poor concrete road is expensive when its total cost per year is considered.

3. Present Status of Concrete Roads

The cost of a pavement is usually met by the selling of debentures. The term of these debentures should not be more than the estimated life of the pavement. The cost of the pavement per year will then be: 1, the sum set aside yearly as a sinking fund; 2, interest on the debentures; 3, the maintenance of the pavement.

In selecting a type of pavement, these three points are usually given a standard percentage value of 44 or 45 per cent. as will be seen from the following:

Table No. 7

Cheapness	14
Durability	20
Ease of maintenance	10
Ease of cleaning	14
Low traction resistance	14
Sanitary qualities	13
Non-slipperiness	7
Favorableness to travel	4
Noise, light, heat	4
	100

These values will vary a little in different localities, but care should be taken not to let the personal interests of a few property holders or residents make changes in the values. A good concrete road built along the line of the above specification and design is not a cheap road. Its cost here runs from two-thirds to three-quarters the cost of the ordinary forms of asphaltic pavements. The life of this high specification road should be at least 20 years with very low maintenance charges. It is easily cleaned, is sanitary, has a very low traction resistance and is not slippery. The worst features, those of noise and reflection of heat and light receive very small percentage values in the foregoing table, which is the same as that used in two of the most recent books on pavements.

Concrete as a pavement is used to-day: 1, on country roads; 2, streets in towns; 3, lanes in large cities; 4, streets of moderate traffic in cities.

It is probably not rated as highly as the preceding remarks would indicate, but the specifications have not been so high until the last year or so.

As engineers realize more and more that the only economical method is one which is based on higher specifications and careful designing, and as the knowledge of how to carry out these specifications increases, the rating of concrete as a pavement will rise and its use will become more general.

The Fourth American Road Congress

The fourth American Road Congress held in Atlanta, Ga., last month, is claimed by the United States press to have been the greatest good roads meeting ever held in any country in the world. The convention was held under the direction of the American Highway Association, the American Automobile Association and many other national and state bodies. The actual registration numbered more than three thousand.

Mr. Austin B. Fletcher, President of the Congress, who is also State Highway Engineer of California, called attention in his opening address to the fact that the purposes of the American Road Congress were to bring about better legislation, better financing of road construction and maintenance, better methods of construction and maintenance, better regulation of traffic and a careful study of the possibilities of convict labor for road improvement.

Mr. Logan Waller Page, President of the American Highway Association, and Director of the United States Office of Public Roads, pointed to the fact that during 1914 more than 18,000 miles of hard surfaced roads had been constructed in the United States—more than three-fourths the length of the entire national road system of France. He urged that greater efficiency be sought and he believed it possible to save from the annual expenditure now reaching more than $205,000,000 a year at least 25 per cent., or $50,000,000, through efficient management. An exceptionally large number of men eminent as highway engineers presented in keen analytical papers the different problems connected with the building and maintenance of roads. Among these were notable papers by Henry G. Shirley, Chief Engineer of Maryland, on Heavy Traffic Roads; by S. Percy Hooker, State Superintendent of Highways of New Hampshire, on Light Traffic Roads; by Col. Wm. D. Sohier, Chairman, Massachusetts Highway Commission, on Maintenance of Surfaced Roads; by Austin B. Fletcher, State Highway Engineer of California, on Rights of Way; and by Henry W. Durham, Chief Engineer of Highways of New York City, on Street Construction and Maintenance.

Erratum.—In an article relating to the Exshaw plant of the Canada Cement Company, published in our issue of November 11, a statement was made that the steel work was fabricated by the Toronto Structural Steel Company, whereas the steel for the Pack House, amounting to about 150 tons, was furnished by the Structural Steel Company, Limited, of Montreal. We are advised that there is no connection whatever between the two companies.

MAINLY CONSTRUCTIONAL

EAST and WEST — FROM COAST to COAST

EASTERN CANADA

The erection of a Collegiate Institute at a cost of $125,000 is under discussion at Guelph, Ont.

At Toronto, last week, a permit was issued to the Excelsior Insurance Company for a brick and stone building estimated to cost $100,000.

The Westlake Brick & Products Company, Limited, Wellington, Ont., has been incorporated with a capital of $250,000.

Plans are being prepared for a dry dock which is to be built at Halifax at a cost of $3,000,000. The dimensions of the dock will be 1,150 ft. long by 180 ft. wide.

The Dominion Public Works Department is preparing plans for a new drydock at Halifax. The structure will be 1,150 ft. long and 180 ft. wide, and will cost $3,000,000.

Mr. E. A. Wallberg, Toronto, is negotiating with the City Council for permission to build a street railway line 4½ miles long from Leaside to Merton Avenue in North Toronto.

Options are reported to have been secured on two sites at Owen Sound for the erection of a drydock. A bonus of $200,000 was voted toward the enterprise last summer. The project is estimated to cost $1,500,000.

New paving work at Quebec, for which plans have been prepared, is estimated to cost $180,000. The work is in sections of St. Louis and St. Foye Roads. The engineer in charge is Mr. W. D. Baillarge, of Quebec.

The Canadian Inspection and Testing Laboratories, Limited, Montreal, and the Mannesmann Tube Company, Limited, Montreal, have been licensed as extra-provincial companies to carry on business in British Columbia.

The Polish Catholics of West Toronto have purchased a site for a new church on Davenport Road. It is proposed to erect a building next spring. Rev. Father Boyarcynk is in charge of the parish, which is newly organized.

Operations are to commence at once by day labor on the extension of the Quebec water-works, which is to be undertaken at a cost of $120,000. The scheme is to be carried out under the supervision of Mr. T. A. Jardine Forrester.

Sir Adam Beck gave an illustrated address on the work of the Hydro-electric Power Commission, at a meeting of the Engineering Society of the Faculty of Applied Science, held in Convocation Hall, Toronto, on Wednesday, November 18.

The contract has been awarded for the new steel and concrete bridge which the Provincial Government of Quebec is to erect between St. Johns and Iberville, at a cost of $175,000. The general contractors are Messrs. Laurin & Leitch, Montreal.

Mr. T. Aird Murray, consulting engineer, Toronto, has been instructed to prepare plans and specifications for the construction of an up-to-date filtration plant, sewerage and disposal systems for Mimico. The initial cost is estimated at about $125,000.

At Montreal, the R. C. parish of St. Patrick is building an assembly hall on Dorchester Street at a cost of $135,000. The building, which was designed by Mr. J. P. Hynes, and for which Messrs. John Quinlan & Company were the general contractors, is practically completed.

The plant of Armstrong, Whitworth of Canada, Limited, at Longueuil, P.Q., will be in full operation early this month. The company will manufacture high speed steel and also tools, while next year the company will make drop forgings. Mr. W. Furniss Clarke is the superintendent.

Messrs. M. Beatty & Sons, Limited, Welland, Ont., have opened a district office in Toronto at the Builders' Exchange, 154 Simcoe Street. Their representative is Mr. K. McKee, formerly of Welland. Latterly Messrs. Beatty & Sons have been represented by Messrs. H. W. Petrie, Limited.

Mr. John Grieve has been appointed in charge of the Montreal office of the Dominion Paint Works, Limited, of Walkerville, with office in the Eastern Townships Bank Building. Mr. Grieve will look after their interests in the provinces of Quebec, New Brunswick and Nova Scotia.

The new office building which the Liverpool, London & Globe Insurance Company is erecting at Montreal at a cost of $175,000 is rapidly nearing completion. The architects are Messrs. Nobbs & Hyde, and the general contractors Messrs. E. G. M. Cape Company, both Montreal firms.

The fire which occurred recently at the new factory which the Canadian Kodak Company is building at Mount Dennis, Ont., at a cost of $500,000, caused damage estimated at $25,000. As a consequence a considerable number of laborers were laid off temporarily, but work has now resumed.

Building operations are reported brisk at Amherst, N.S. During the last few months some sixty new residences, mostly of a superior type of construction, have been erected. These, with the Goodwin block and the Armoury building, will bring the total expenditure to quite a respectable figure by the end of the year.

The Old Peoples' Home at St. Laurent (Montreal) has reached the roofing stage. The building, which is three-storeys high, of reinforced concrete construction, has been erected by the Atlas Construction Company according to the design of Mr. A. Piche. Work will be continued throughout the winter. The total expenditure is $250,000.

At Quebec, operations are proceeding on the new post office which is being erected by the Dominion Government at a cost of $500,000. Plans were prepared by A. R. Decary, and the architect in charge is Mr. E. M. Talbot. Louis Boivin is the general contractor. The building is to be six storeys high, of stone, reinforced concrete and terra cotta construction.

Mr. A. D. Swan, of Montreal, the former assistant harbor engineer, is in England, and will give evidence for the Bristol Corporation in a legal case involving about $1,000,000. Mr. Swan was on the harbor engineering staff of the Bristol Corporation prior to coming to Canada. Since leaving the Montreal Harbor Commission he has been engaged in practice in Montreal as consulting engineer.

An estimate of the cost of raising Grand Trunk tracks in the city limits is included in a report presented to the Montreal City Council. The estimate is that of the company and totals $8,211,000. It is made up of the revised estimate of $5,903,745 with the addition of the following percentages: for general expenses and contingencies, 5 per cent.; for interest on cost of construction for two years, 6 per cent.; consequential damages, $500,000; commission for financing, 3 per cent. The engineering questions involved are now under study by Mr. G. R. Macleod, city engineer on railways and bridges. Mr. Macleod is engaged chiefly in checking the estimates and determining how far expenditure has been entailed by changes asked by the city.

Mr. B. P. Richardson, late superintendent for Messrs. Ross & Macdonald, of Montreal, has opened an office at 54a Beaver Hall Hill, Montreal, with agencies for hydraulic and municipal engineering supplies. Mr. Richardson, who has had twenty years' experience in different parts of the world, represents several well-known firms and is now equipped to give quotations to city engineers and others.

Mr. T. J. Kennedy, of Sault St. Marie, Ont., president of the Superior Construction Company, Limited, is a man of many parts. He is actually president and general manager of no less than six companies in addition to the office he holds in the construction company. To enumerate these there are the Algoma Central and Hudson Bay Railway, the Algoma Eastern Railway, Algoma Central Terminals, Limited, Algoma Eastern Terminals, Limited, the Superior Rolling Stock Company, Limited, and the British American Express Company, Limited. Mr. Kennedy also holds office in nearly half a dozen other firms. Born at Campbellford, Mr. Kennedy was educated at Port Hope, Ont. Early in life, in 1874, he entered the service of the Engineering Department of the Canadian Pacific Railway, under Sir Sanford Fleming. A few years later he was engineer for the contractors for Section B of the C. P. R. Through the succeeding years he has advanced through various stages to the many important offices that he now holds.

WESTERN CANADA

The Safety First Air Brake Company (Canada), Limited, Victoria, B.C., has been incorporated with a capital of $300,000.

Mr. J. L. Harrington, Kansas City, delivered an address on bridge work at a recent meeting of the Victoria Branch of the Canadian Society of Civil Engineers.

At Medicine Hat a new factory built for the Saskatchewan Iron & Bridge Works has been completed at a cost of $100,000. Machinery has not yet been installed.

At Winnipeg, Fred W. Leistikow is said to have invested $100,000 in the Happyland subdivision, with a view to erecting dwellings valued at $6,000 each. His total investment will be $300,000.

A Strauss lift bridge was put into operation recently across the Fraser at Fort George. This bridge is 2,654 feet long and required 6,500 tons of steel in its construction. The structure entailed an expenditure of about $1,500,000.

Plans for the second unit of the plant which is to be erected at North Vancouver at a cost of $5,000,000 by the Dominion Shipbuilding and Drydock Company, Limited, have been sent to Ottawa for approval. It is intended that constructional operations shall be started in two weeks.

Good progress is being made with the execution of machine shops and roundhouse for the Grand Trunk Pacific at Prince George, B.C. This district is showing rapid growth and it is probable that there is no other locality in British Columbia in which greater building activity is taking place. During the last three months there have been completed nearly $500,000 worth of new residences and business blocks, while at the present time there are buildings valued at $250,000 under construction.

Progress on the Kettle Valley Railway is so advanced that the line will probably be ready for traffic to the Coast next summer. The Kootenay Central Railway, another branch of the C. P. R. in British Columbia is also well on the way to completion, the Swing Bridge over the Columbia River, near Lake Windermere, having been put into position. Construction on this line has been carried on both northwards from the Crow's Nest Line and southwards from Golden, and this bridging of the Columbia River will enable the two ends to meet.

Clay Products Men to Convene Next Month

THE annual convention of the Canadian National Clay Products Association is to be held January 26-28 next, at the King Edward Hotel, Toronto. An attractive programme has been prepared and a record meeting is anticipated. The President of the Association is Mr. Chas. A. Millar, Toronto, well known as a contributor to this journal; the First Vice-President is Mr. Henry Stevens, Portage la Prairie; the Second Vice-President is Mr. John S. McCannel, Milton, Ont; the Third Vice-President is Mr. J. Edward Frid, of Hamilton, and the Secretary-Treasurer is Mr. Gordon Keith, of Toronto. Among those scheduled to deliver papers are Professor M. B. Baker, Queen's University, Kingston; Dr. A. C. McKay, Principal, Toronto Technical Schools; Mr. A. F. Greaves-Walker, Ceramic Engineer, Manager of the Sun Brick Company, Toronto; Mr. E. W. Knapp, Ceramic Engineer, with the Sun Brick Company, Toronto; Mr. W. W. Smith, Shallow Lake, Ont., and Mr. Andrew Kruson, of the Sun Brick Company. The opening session will be held at 10 a.m. on Tuesday, January 26, when members will register and secure banquet and theatre tickets at the King Edward Hotel. The convention proper will open at 2.30 p.m., when the meeting will probably receive an official welcome from prominent civic officials. In the evening the convention will be entertained at one of the local theatres by the Entertainment Committee. On the second day of the convention—Wednesday, January 27, there will be morning and afternoon sessions devoted to papers and discussions. A smoking concert will be held in the evening. The closing date is Thursday, January 28, when the day will be occupied by papers and discussions and the business of the Association, the whole proceedings being brought to a close in the evening by a banquet. It is hoped that every manufacturer of clay products in the country will make an effort to attend. Enterprising measures are being taken with a view to making the convention the most successful in the history of the Association and the co-operation of the trade is solicited to this end.

Mr. Chas. A. Millar, President of the Canadian National Clay Products Association.

Contracts Department

News of Special Interest to Contractors, Engineers, Manufacturers and Dealers in Building Supplies

Waterworks, Sewerage and Roadways

Brantford, Ont.
Operations have started on the construction of a Park Drive, 20 ft. to 40 ft. wide and 50,000 cu. yds. of embankment, for this city. Work is being carried out by day labor under the supervision of Mr. T. Harry Jones, City Engineer. Bridge over Hydraulic Canal will not be started this year. Mr. F. Cockshutt is Secretary, Parks Board.

Cochrane, Alta.
The municipality of Cochrane has in contemplation the installation of a waterworks system next year. Mr. J. E. Laird is secretary-treasurer.

Calgary, Alta.
The Weno Power & Light Company has applied for permission to lay water and gas mains and to construct transmission lines for electric power in sections 10 to 16, Township 24, Range 29, Section 18, and Township 24, Range 28, Alberta. Messrs. Griffiths, Ford, Wright & Miller, of Calgary, are the firm's solicitors.

Galt, Ont.
The Town Council is laying about one mile of 10-in. water mains on macadamized road and 1,200 ft. of 18-in. water mains on Water Street South. The latter work will be done this winter. Pipe has not yet been purchased. Canadian manufacturers have been asked to submit new prices. Mr. Jas. McCartney is the town clerk. The estimated cost of additional waterworks system is $55,000.

Hamilton, Ont.
Estimates will be prepared and reports made by Messrs. Kerry & Chace, Confederation Life Building, Toronto, engineers, in connection with new reservoir to be erected on Mountain Top for the Board of Control.

Tenders for pump house and pumps in connection with sewerage scheme in east end, estimated to cost $130,000, will not be called until next summer by the Board of Control. A quantity of cement, broken stone and reinforced steel will be required. Trenching work has been started by day labor. Mr. A. F. Macallum, City Hall, is the engineer.

Morris Township, Ont.
The Township Council here have decided to construct a number of tile drains in the township. Mr. Alex. McEwen, Bluevale, is township clerk.

Mimico, Ont. (Toronto)
Work is expected to start as soon as debentures have been sold, on the construction of a water and sewerage system here at an estimated initial outlay of $125,000. Plans now being prepared will be submitted to the Village Council before work is proceeded with. Mr. T. Aird Murray is consulting engineer.

Niagara Falls, Ont.
Surveys have been made preparatory to the construction of sewers on Queen and Bamfield streets at an estimated cost of $3,000 for the City Council. Work, which will consist of enlarging Queen Street sewer and laying new sewer on Bamfield Street, is to be done by day labor under the supervision of the engineer, Mr. F. J. Anderson.

New Westminster, B.C.
The Board of Works has been authorized to proceed at once with the construction of a new reservoir here. Work will be done by day labor. Mr. J. W. B. Blackman is engineer.

Ottawa, Ont.
Work will start immediately on the laying of a tile pipe sewer between the G. T. R. and Carling Avenue. Solid rock excavation will be necessary. Work is to be done by day labor. Mr. R. L. Haycock is engineer-in-charge.

Ottawa South, Ont.
By-law will be voted on by ratepayers next January for the construction of intercepting sewer in Ottawa South district for City Council.

Preston, Ont.
The construction of pavements on Waterloo, Queen, Hamilton, Argyle and Duke Streets, is contemplated by the City Council. The city clerk is Mr. H. C. Edgar.

Port Dalhousie, Ont.
The Village Council has under way arrangements for the laying of a watermain connected with St. Catharines water system for the purpose of supplying Port Dalhousie with water. Mr. J. M. A. Waugh is village clerk.

Point Grey, B.C.
Tenders will be received by Mr. G. G. Heighway, Kerrisdale P. O., until December 7th, for paving Fourth Avenue from Alma Road to Blancha Street, at an estimated cost of $50,000. Plans and specification are with the town engineer, Town Hall.

Quebec, Que.
Plans have been drawn for paving work at an estimated cost of $27,000 from St. Valier Street to City limits. Mr. W. D. Baillarge, City Hall, is engineer-in-charge.

Toronto, Ont.
Tenders are invited by the Board of Control for the following materials: brass and bronze castings; brass work for house services; cast iron pipe; hydrants; lead pipe; special castings; stop valves. Plans, etc., at Room 12, City Hall.

Vancouver, B.C.
Plans are in progress upon the completion of which work will be started on the construction of "Clark Drive" trunk sewer, estimated to cost $325,000, for the Vancouver and District Joint Sewerage and Drainage Board, 718 Granville Street. It has not yet been decided whether to let the contract or to do the work by day labor. The company's engineer has charge of the work.

West Vancouver, B.C.
Plans have been prepared by Mr. H. McPherson, Hollyburn, engineer, for a waterworks system estimated to cost $150,000 for the Municipal Council. The source of the supply is to be the head of Sister's Creek where dam 26 ft. high and 10 ft. long will be constructed. Operations are to begin in January.

Winnipeg, Man.
A by-law is to be voted on for the laying of sewers on a number of streets. Work is to be done by day labor and will be carried through this winter. Mr. W. P. Brereton, 223 James Avenue, Winnipeg, is the City Engineer.

CONTRACTS AWARDED

New Westminster, B.C.
The tender of the British Columbia Transport Company has been accepted by the Board of Works for the supply of 4-in. and 6-in. vitrified sewer pipe in connection with the city's water supply scheme.

Toronto, Ont.
York Twp. Council has awarded to Mr. J. C. Scott, Lambton Mills, Ont., the general contract to construct sewers on Glenholme and Earnscliffe Avenues, estimated to cost approximately $20,000. Mr. Frank Barber, 57 Adelaide Street East, is the engineer.

Board of Control (Commissioner of Works, Mr. R. C. Harris), has let the contract for supply of pipe and laying of 72-in. conduit in connection with pumping and filtration plant at Toronto Island, to Messrs. Roger Miller & Sons, Limited, Toronto.

The following contracts for sewer construction in this city have been let by the Board of Control (Mr. R. C. Harris, Commissioner of Works): Provincial Contracting Company, Bingham, $2,987, Kingswood, $1,310; McKnight Construction Company—Eastern, $3,844, Swanswick, $4,982; Mr. W. E. Taylor—Wheeler Avenue, $1,343; Mr. M. H. Murphy—Victoria Avenue, $3,952; Asphaltic Concreting Company—Medland, $315; Commissioner of Works, City Hall—Alton Section, $8,750. Tenders for Evans Avenue have been referred to Commissioner for report.

Watford, Ont.
The contract for repairing Kent drain has been awarded by the Village Coun-

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Alphabetical Index of Advertisers
Page 18

Vol. 28 December 9, 1914 No. 49

Principal Contents

Page
The Day of the Capitalist and the Prospective Builder 1479-80
Engineering Topics in the Old Land 1480-1
By the London, Eng., Correspondent of the Contract Record
A Menace to Honest Contractors 1481
Constructional Features of the Five-Million-Dollar Plant of Canadian Vickers, Limited 1482-92
Hydrated Lime in Concrete 1493
The New Sewage Disposal Plant at Aberdeen, S.D. Part II., Conclusion 1494-1500
By W. G. Potter
An Investigation of the Discharge of Inflammable Wastes Into Sewers 1501-4
Road Construction Plant and the Contractor 1504
Personal Mention 1505
Constructional News 1506-7

The Day of the Capitalist and the Prospective Builder

It is not a far cry back to the time when capitalists and prospective builders were postponing their constructional enterprises owing to the high cost of building. Yesterday, as it were, the brick manufacturer, the supply dealer, the mechanic and the laborer had it all their own way. Brick-makers filled orders as a favor, supply dealers admitted of no cut except to "friends in the business," and mechanics and laborers stood unflinchingly by the arrangements made by their unions. These men, during a period of unexampled prosperity, had established themselves in a position of supremacy. Now, however, the fortunes of war and business fluctuation have changed everything and the old order has given place to the new.

To-day, of all times in recent history, is essentially the day of the capitalist. No longer does the prospective builder have to use persuasion to get the contractor to figure on his building or the brick manufacturer to provide regular deliveries to keep the work going; nor has he to speculate as to the attitude of labor. Any man with capital at the present time has the opportunity of his life. If ever he had an idea of undertaking new work or constructional extensions and he does not get his operations under way now, he will only regret it once—and that will be all his life.

It is a hard admission to have to make, but builders and contractors are now figuring to a hair's breadth on new work. With the outlook of winter before them and a quiet period behind them it is only natural that they should exert every effort to obtain work which will assure a busy opening in the spring. There was never a time when contractors and builders showed such enterprise in following up their opportunities. Looking ahead to the period of activity that must follow the cessation of activities, it is hard to imagine that in our day these men will ever be found so approachable again.

Time was when we heard of collaboration among contractors. According to some people, never a job was estimated but a certain coterie, in which Brown and Smith always figured, had their heads together in a comparison of figures. But things are no longer "fixed" between Brown & Smith. Brown might have made a little money in good times, but it is all "tied up." Smith has had a few bad "bumps." Brown has to live; so has Smith. The Brown-Smith partnership is dissolved by common consent.

We referred above to the reduced price of the materials of construction. Perhaps a few hard facts will bring this home more clearly to the man with money. In the last six months the price of building materials as a whole has steadily gone down, due in part to depreciation in constructional work, but more particularly to decline in speculative building. The reaction caused by these factors in the situation has resulted in important changes in the labor market. The demand for both artisans and laborers has eased off considerably, and labor, which not so very long ago was at a premium, is now at a considerable discount. With these facts in mind it were almost superfluous to emphasize the unique advantages which to-day lie at the very doors of those who are in a position to prosecute building work in anticipation of the boom in industrial activity which is certain to come after the conclusion of the war.

To cite a few examples of downward tendencies in building supplies, it may be pointed out that brick, the staple product in the building trade, is available at the present time on the most reasonable terms that have been met with for a long time. In the last six months quotations for common stock brick have dropped $1.00 to $2.50 a thousand, while the reduction in several other kinds is even more pronounced. Cement and lime fluctuate very slightly at any time, but crushstone has dropped 5 to 15 cents in the same period. Hydrated lime to-day is nearly a dollar below its price six months ago, and products such as paints and oils have fluctuated considerably. With these facts before us, taken in conjunction with the general situation and the evidences of trade revival at hand, we cannot arrive at any other conclusion than that the present offers an opportunity almost unique in the history of this country for the judicious investment of money in constructional works.

It may be argued that we have admitted the weak position of the interests whom we are called upon to serve. This may be so, but in any event weakness may become strength under skilled treatment, and we believe that a candid admission of the situation, with an honest effort to improve business conditions to the mutual advantage of the contractor and his principal, will contribute considerably to improving the general status of conditions.

Engineering Topics In The Old Land

The Institution of Civil Engineers: Mr. Blyth's Presidential Address—Kaiser Wilhelm No Longer an Honorary Member — "Damned Little Dots" in Engineering Reports

Special London, Eng., Correspondence of the Contract Record

London, Eng., Dec. 1.

THE inaugural address of the newly-elected president of the Institution of Civil Engineers is regarded in the Old Country as an important annual event. The instituton is certainly father of all other bodies of its kind, and even on the score of age alone it is entitled to the respect and good wishes of all members of the engineering profession. The new president is Mr. Blyth, a Scotsman, and although by no means the first of that persevering and thrifty nation to occupy the presidential chair, he is the first engineer practising in Scotland to be thus honoured. As it happens, however—and the point would appear to have been overlooked by Mr. Blyth—the institution is not a Scottish body. It is essentially British, and the greater is generally understood to include the less. As a British institution, a president in his address deals usually with British engineering, and does not confine himself to that portion of the Empire in which he has been raised. Mr. Blyth, however, took as the general subject of his address the progress of engineering in Scotland during the last half century, and it is to be hoped that, in the exercise of the important duties which he will be called upon to perform during his year of office, he will shake himself free from this parochialism. One of the most interesting duties of an occupant of the chair is the handing out of work to the satellites that revolve around it. This again is handed out to the lesser satellites, and from them to the bottom dogs who live upon what morsels of fat may be thrown to them. Scotland has conquered England years ago, not by force of arms, but by intellect, persistence and adaptability. Fleet Street is merely a Scottish colony, and every newspaper office is a receiving ward for needy "brithers." Westminster is now undergoing the process of annexation, and unless Mr. Blyth uses wisely and broad-mindedly the great powers vested in his office, the capitulation of the hard-pressed English garrison is certain.

An Engineer de Luxe

An early duty of the Institution should be the revision of its list of members. In the list for 1914, the first name among the honorary members is "His Imperial Majesty Wilhelm II., German Emperor and King of Prussia," and it would be interesting to know what qualifications he had for election. To think oneself an engineer is not to be an engineer, and there seems to be no reason in the election even to honorary membership of men who are not engineers. "Honorary members," say the by-laws of the Institution, "shall be either distinguished individuals, who from their position are enabled to render assistance in the prosecution of public works, or persons eminent for science and experience in pursuits connected with the profession of a Civil Engineer, but who are not engaged in the practice of that profession in the United Kingdom or its dependencies." Surely the ability to render assistance in the prosecution of public works should not be a sufficient qualification, as judged by this standard a banker, a financier or a moneylender would be eligible in the highest degree. Wilhelm II. has, however, now been expelled from the roll, "by unanimous vote," but whether this vote includes that of sundry other undesirables history does not say. Anyway, the Kaiser has been saved the trouble of "notifying in writing" his recent many changes of address, although he has no doubt been annoyed by the "miscarriage of the publications and other communications from the Institution." To put the matter in a nutshell, an engineering institution is for engineers, and none other should be admitted. Another matter calling for attention in connection with a revision of the roll was referred to by Mr. Blyth in his presidential address, but it is difficult to see what can be done, even were action desirable. Members are not allowed to advertise, as is well known, and it has grown into a common practice for companies served by members to use the names of such members in their advertisements. That the question is receiving the "most anxious consideration of the council," one can quite understand!

The Unnecessary Decimal

The High Road, Chiswick, is one of the great western arterial roads radiating from central London, and the surveyor to the urban district council has recently taken a traffic census on the lines laid down by the Road Board in connection with the classification of roads. The census extended over one week of seven days, from 6 a.m. to 10 p.m. each day, and if any proof was wanted of the rapid increase of motor traffic in London during recent years it is to be had here. The following are "average number per day" figures: Motor cars, 1,447.48; motor omnibuses, 976.71; motor vans, lorries, tractors (excluding trailers) and traction engines, 350.27; motor cycles, 197.14; giving (with trailers) a total of 3 010.85. In addition to this electric tramways totalled 1 235.42. The total number of horsed vehicles was 2,065.0, of which horsed omnibuses were responsible for the very modest figure of 1.71, while of horsed tramways there were none. Had the census been taken in, say, Knightsbridge—which is a continuation of the same road, but much nearer central London—the preponderance of mechanically propelled traffic would have been infinitely greater. In dealing with figures such as these the decimals seem redundant. The figure for horsed omnibuses might just as well have been 2 as 1.71, and the same applies to the figure for "sheep and pigs" the average number of which is also 1.71 per day. The one would be quite as near in the average of a year of weeks as the other, and while the mind can conceive the daily passing of a sheep or a pig it cannot visualize the passing of .71 of either animal. A traffic census on precisely similar lines is to be taken in every city, town and district throughout the country, and the returns would be much simplified if "those damned little dots" were dispensed with.

A Superfluous Damp Course

Happily, the concrete raft which covers the site of the new London County Hall has escaped the observation of the irresponsible journalist. This raft is of concrete, 5 ft. thick, and would form an excellent base for German guns! Its surface is 3 ft. above low water level in the Thames, and by simply knocking down the granite and concrete retaining wall (of a thickness of from 5 to 10 ft.) and diverting the flow of the river splendid "pots" at the Houses of Parliament, Westminster Abbey and other buildings could be obtained. It might be argued that the building itself would have to be removed, but there is no possibility of this being erected until long after the termination of the war—if matters progress at the same rate as they have of late. There is one interesting point about this raft. It consists of five 12-in. layers of concrete (six parts of aggregate to one of Portland cement) and from it all walls are carried up direct, without the intervention of footing courses. Upon the first layer of concrete, 1 ft. thick, a ¾-in. dampcourse (of one part Portland cement to one part sand) is spread, and the remaining 4 ft. is then added, giving a total thickness, it would seem, of 5 ft. 0¾ in. The question is: What useful purpose will this dampcourse serve? Everyone knows that concrete is never absolutely impermeable, no matter what care may be exercised as regards its composition, mixing and laying. But then, is a ¾-in. layer of sand and cement impermeable? The bottom of the concrete is one foot below low water level and 20 ft. 6 ins. below high water level, and one cannot but think that any upward pressure of water arising from such conditions would as easily force a ¾-in. cement dampcourse as a 5 ft. cement concrete raft. Any cracking of the concrete, too, would mean cracking of the dampcourse. A more effective treatment (to cite only one method) would surely have been to regard the vault, i.e., the space between the raft and the ground floor of the building, as a tank and to have given it an asphalt lining. The usefulness of a cement dampcourse in such a position is quite hypothetical, and it was a wise precaution to add a further dampcourse of asphalt, ½-in. thick, to all piers and walls, at a height of 1 ft. 6 ins. from the surface of the raft.

A shortage of potash exists owing to the interruption of imports from Germany, according to the Sydney Cement Company. The company claims that many of our soils have a good supply of potash, available only to a limited extent because it is insoluble and that the application of ground limestone will give conditions which will render potash soluble.

The water used in mixing concrete should be free from oil, acid, strong alkalies or organic matter. Water carrying in suspension considerable quantities of mineral or vegetable matter should be rejected.

A Menace to Honest Contractors

IN a recent issue of the Secretary's monthly letter, the Master Builders' Association of Boston, calls attention, rather forcibly, to measures adopted by contractors to secure competitors' figures, and cites the following as an example.

"A general contractor's office is called up on the telephone and the statement is made that an estimate had been given by the person talking, but that the latter's estimator had gone out of town carrying his estimate book with him. He then asks if the general contractor will kindly give the amount of the estimate to the party talking, so that the latter might furnish other general contractors with a bid."

Concerning this the letter states, "The damnable practices by which honest contractors are defrauded, apparently ignoring all matters save the low bid, and by skinning and stealing, have brought the building down to a mighty mean estate."

The letter then appeals to the owners. It asks them to readjust their conceptions of competition, and to make the factors of ability of performance of work, reputation for reliability, fairness and decency of treatment as the weight against low bidding. It says that owners should bear in mind that an unscrupulous general contractor can easily take out of the owner all and more than the difference between his low bid, and that of a contractor who can not persuade himself to do unworthy things. The statement is made that competition rests upon something more significant than the difference in price or time of execution. It asks that architects urge their clients to comprehend that ignoring this fact and the persistent awarding of contracts to merely the low bidder on a job inevitably leads to the complete discouragement of those who wish to do work on the square.

It says, in conclusion, that unless a change in the attitude of owners is manifested soon the wholesomeness of the building business will be totally destroyed, and that the chief sufferers will be those who pay the bills.

A report prepared by the Illinois Chapter of the American Institute of Architects upon the problem of estimating by contractors under the present methods states that members of the Chapter investigated the office work of five representative contractors. They found that the average number of contracts estimated by each contractor in one year was twenty-two, the average number of jobs which he obtained from these estimates was ten. The average value of the time spent by the office force of each firm on each estimate, including additions by sub-contractors and material men, was $503. The Report points out that the cost of six bids on a building costing between $100,000 and $150,000 ran to over $3,000, that is, between 2 and 3 per cent. of the whole cost of the work. Perhaps in no other business to-day is so much unproductive work done at so high a cost.

Owing to the deficiency in the Ottawa water supply, the local agents of all fire insurance companies have been notified by the Fire Underwriters' Association to increase their rates from 25 to 50 per cent. All rates on manufacturing and mercantile risks are to be increased 50c. on the dollar in all new business. On residential buildings the increase is to be 25c. on the dollar for three-year policies.

General view of the plant of Messrs. Canadian Vickers, Limited.

Constructional Features of the Five-Million-Dollar Plant of Canadian Vickers, Limited

IN 1910 the Dominion Government passed an Act known as the Dry Dock Subsidy Act. This Act had for its purpose the encouragement of the construction of graving dry docks or floating dry docks, capable of taking the largest vessels frequenting the River St. Lawrence.

Messrs. Vickers, Limited, of England, were one of the first companies to contract with the Government for the construction of a floating dry dock and ship repairing plant. Messrs. Vickers, Limited, as is well known, is one of the largest shipbuilding concerns in Great Britain.

After the preliminary negotiations had been completed with the Government, a company now known as Canadian Vickers, Limited, was formed and has carried out the work described below.

A site having an area of about 40 acres located in the municipalities of Maisonneuve and Montreal, on the north bank of the St. Lawrence, adjoining the easterly limits of the habour, was selected. Work on the reclamation of the site for this enormous plant was started in 1910, and today, as the several buildings are nearing completion, it can readily be understood that this addition to Canada's long list of industries is of extraordinary value. The new plant when completed will have cost $5,000,000.

As many engineering and constructional features have developed in connection with the work, we believe that a description of the plant will be of interest. A study of the general lay-out will show that the work when completed will include the following units: Fitting-out Basin, Floating Dock, Mechanics' Shop, Joiners' Shop, Pump House, Iron-Workers' Shed, Smiths' Shop, Plumbers' Shop, Gas Producer Plant, Shipbuilding Berth, Central Heating Station, Gate House and General Stores, Electrical Shop, Test House, Power House, Paint Shop, Boiler Shop, Engine Shop, Brass Foundry, Administrative Offices, also Garage, Ambulance Room, Stores, etc.

The several buildings are grouped on each side of the fitting-out basin and shipbuilding berth, which together divide the site. A description of each of the units comprising the entire plant follows:—

FittingOut Basin.—Length 1,000 ft., width 500 ft., with a depth of 30 ft. at the sides and 50 ft. in the centre at extreme low water level. Concrete retaining walls on each side, extending to a height of 28 ft. above water level. Width of walls on top, 12 ft. A sinking basin 875 ft. long, 150 ft. wide at the bottom, and 50 ft. deep below low water level, is located in the centre of the basin. Into this sinking basin the floating dock is lowered when about to take on a vessel. The tops of the retaining walls on each side of the basin form quays which are served by standard gauge tracks connecting with all parts of the works, and the main railway lines on the north side of the site. The concrete walls of the basin and shipbuilding berth were built by the Montreal Harbour Commissioners. The outer or harbour section of the walls, 1,200 ft. in length, built by the Commissioners, are on crib foundations. The retaining walls of the shipbuilding berth are on concrete piles of the pedestal type, 405 piles being used. About one million and a half cubic yards of earth were dredged from the river and deposited to form the site on which the buildings now stand. 45,000 cubic yards of concrete were placed in the retaining walls.

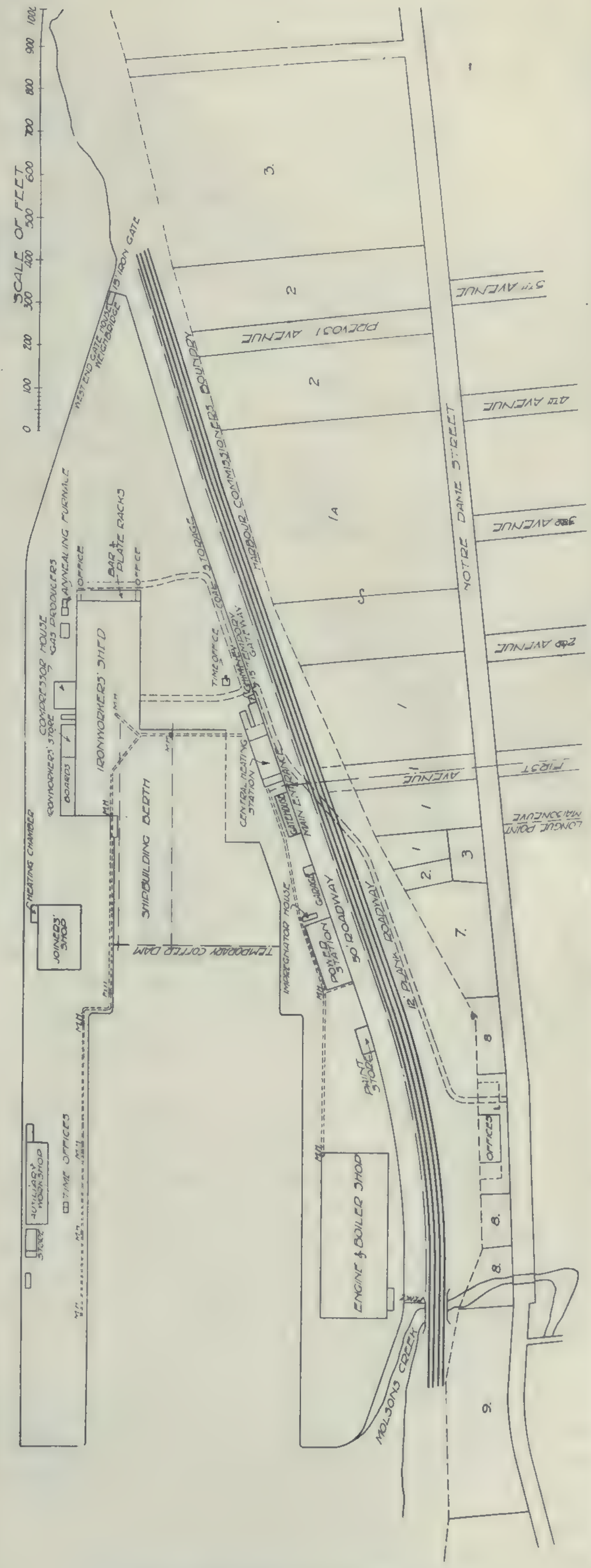
Floating Dock.—This dock, named the Duke of Connaught, constructed entirely of steel, was built at the naval construction works of Vickers, Limited, at Barrow-in-Furness, Eng., and was towed to Canada in September, 1912. Clarke & Stansfield, marine engineers, London, England, were the designers. The dock is registered at 17,963 long tons—British Board of Trade measurement. The dock is 600 feet long over all, 100 feet wide over the pontoon deck between side walls, and is constructed in three sections of 200 feet each, open at ends. From the top of pontoon deck to the bottom is 17 feet. The side walls average 40 feet high above deck. When the three sections are coupled together and operated as a unit the dock is capable of raising a vessel 700 ft. long, weighing 25,000 tons in five hours after the pumps are started. For general use one section is used for small vessels and the remaining two sections, coupled together, are kept in readiness for larger boats. In each side wall there is a working or machine deck 12 feet below the top deck of each wall. On these machine decks are located the pumps, boilers, dynamos, engines, and all machinery necessary for operation. The lower compartments in the walls below the machine decks, as well as the main pontoons forming the bottom of the dock, are flooded for the purpose of sinking. In the centre of the lower or pontoon deck is a line of keel blocks, each made up of four pieces of 12 in. by 12 in. oak spaced 2 ft. 6 in. on centres and extending the whole length of the deck. On each side of the keel blocks are the bilge blocks, short oak timbers resting on heavy box beams placed loose on the deck. Each section of the dock is equipped with mechanical shores, four in each wall, which are used for centering a vessel when being docked. On each side wall there are three working altars or platforms at 12 ft. elevations. Compressed air mains extend along each side wall at the pontoon deck level and also at a higher level. There are two steam-driven centrifugal pumps (each having a capacity of 1,500 gals. per minute) to each section of the dock. Forty-eight electrically-controlled valves are used in filling the pontoon compartments. Two 45 kw. steam-driven generators furnish the current for lighting, valve control and crane. Compressed air is supplied to the dock from the shore for the pneumatic tools. Incandescent lamps are used for lighting, those on the top decks being placed on standards. On the top of one side wall is an electric travelling crane of 3 tons capacity. The general service pumps are also fitted for fire service.

In operation, the dock is warped out over the sinking basin. The pontoons are flooded and the dock is sunk until the keel blocks on the pontoon deck are below the level of the keel on the incoming vessel. The vessel enters and is centered over the keel blocks. The pontoons are then pumped out and the dock is raised until the pontoon deck and the vessel are well above water. The dock is then warped back to the wall of the basin and made fast. Two hours suffice for the operation of docking a medium-sized vessel.

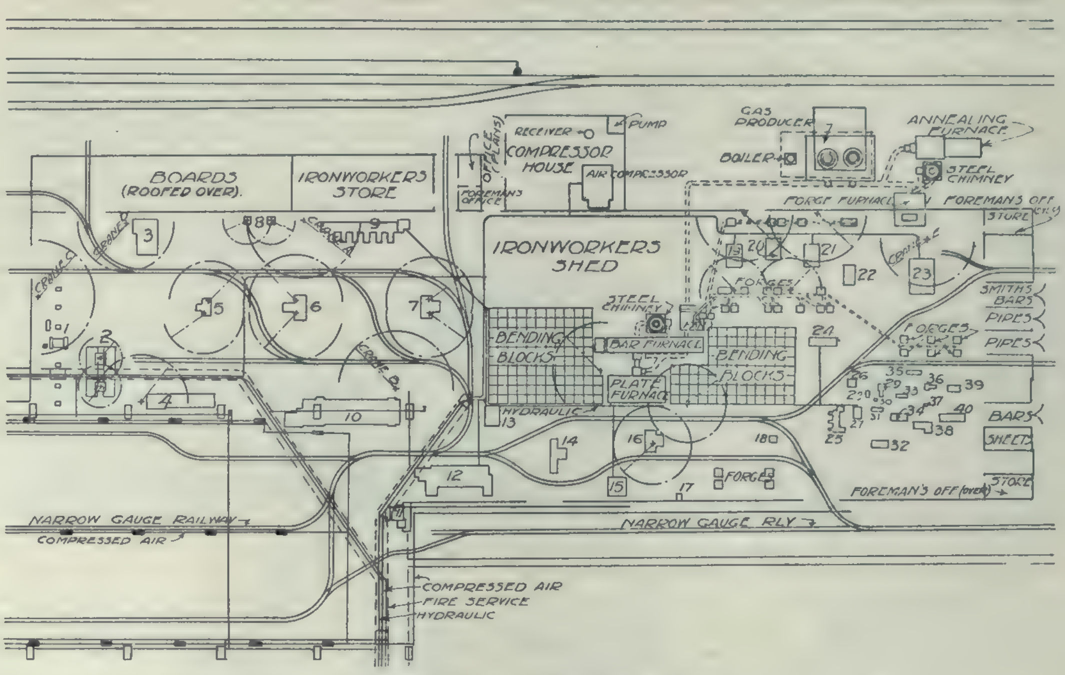
Mechanics' Shop.—This shop—one of the first to be constructed—is located close to the floating dock. The length of the main building is 100 ft. and the width 50 ft. The building is one storey high, with gallery on each side and monitor in centre of roof. The structure is of steel frame, with brick walls and ordinary windows with wooden frames. The roof is tar and gravel, Barrett specification, on double layer of pine boards carried on steel trusses.

There is an extension 90 feet x 50 feet to the east of the main building. In this are located four blacksmith forges, plate heating furnace, 20 ft. x 9 ft., coal burning, and bending slabs. The blast fans for the forges and furnace are located in the extension, also a 500-ft. auxiliary steam-driven air compressor of the Chicago Pneumatic Tool Company's make.

On the main floor of the main building the following machine tools are located: vertical drill, by Bertrams, of Dundas, Ont.; Harvey horizontal, boring, facing and milling machine; Cincinnati horizontal drill No. 3; Jones & Lamson 2¼ x 24 in. flat turret lathe; capstan lathe, used mostly for brass work; metal cutting band saw, Noble & Lund pattern; Archdale 8½ in. spindle lathe; Shanks patent double tool grinder; Barrows patent screw turning lathe ⅜-in. to 1½-in.; 12-in. centre lathe, Dean-Smith & Grace; Archdale radial drill, 4 ft. 6 in. arm.; 12-in. slotting machine,



Canadian Vickers Plant—General layout of site.



Ironworkers' Shed, Canadian Vickers plant.

List of Machines in Iron-Workers' Shed:—(1) multiple punch; (2) radial drills; (3) 8 ft. x 1-in. rolls; (4) 21-ft. bending rolls; (5) 1-in. punch and shear; (6) 1½-in. punch and shear; (7) 1¼-in. punch and shear; (8) radial drills; (9) 36-ft. planer; (10) 36-ft. rolls; (11) roller press; (12) Keel plate bender; (13) joggler; (14) beam bender; (15) swivel cutter; (16) 1-in. punch and shear; (17) fan from import store; (18) circular cutter; (19) 10 cwt. hammer; (20) 10 cwt. hammer; (21) 10 cwt. hammer; (22) 5 cwt. hammer; (23) 2 ton hammer; (24) hydrauilc pipe bender; (25) panel shear; (26) disc grinder; (27) hydraulic flanger; (28) emery wheel; (29) band saw; (30) motor; (31) circular cutter; (32) punch and shear; (33) 2-in. pipe screw; (34) 4-ft. rolls; (35) 4-in. pipe screw; (36) 6-in. pipe screw; (37) motor; (38) 5-ft. rolls; (39) radial drill; (40) 8-ft. rolls; (41) beveller.

Niles, Bement, Pond Company; 4-ft. radial drill, Asquith pattern; gear cutter, up to 8-in., Gleason, Rochester, N.Y.; Archdale pipe flange drilling machine; Archdale double headed shaper, 24-in. stroke; drill grinder; disc grinder; Universal milling machine; horizontal boring, milling and tapping machine.

In the south gallery are located:—metal cutting band saw sharpener, Noble & Lund, the only machine of its kind in Canada; hand-driven band saw setter; brazing furnace for making joints in band saws; high speed, Rice patent, vertical drill (spindle speed, high—2066 r.p.m., low—855 r.p.m., used for light work, 1/16-in. to ½-in. holes.

A tool store is located above on one of the galleries. In the north gallery are the detail drawing and foreman's offices. All heavy machines on the main floor of this shop are on permanent concrete foundations. All the machines except two are motor-driven from line shafts—one on each side wall. Each main shaft is driven by one 20 h.p., d.c. motor, Vickers make. One vertical drill is equipped with individual motor drive—a 5 h.p., d.c. Vickers motor. The repair work on vessels handled by the floating dock is partly taken care of in the mechanics' shop above described.

Joiners' Shop.—Two storeys and basement, length 150 ft., width 100 ft., height 33 ft. to bottom of roof trusses, on concrete foundations. Built in two bays, each 50 ft. x 150 ft., with monitor in roof over each. As this building is located on made ground, 273 concrete piles of the pedestal type were used in the foundations. The basement floor is of concrete, 9-in. thick—reinforced with Clinton wire cloth, and the whole floor slab and side walls of the basement are waterproofed. The roof is of two layers of planks, tar and gravel, Barrett specification. The main floor and first floor are of heavy pine.

The main floor is divided into four sections each 25 x 150 ft. The south section is fitted up with joiners' benches. The second and third sections contain the woodworking machinery and the north section is used as a riggers' loft.

The south half of the first floor is used as a mould loft. This loft has a level pine floor, painted black as usual. The north section of the first floor is to be a sail-makers' loft. Between the sail loft and mould loft is a space left open for the purpose of giving direct light to the main floor below.

In the basement are located a drying room and wood storage on the south side and all shafts and motors used for driving the machine tools above. The drives are grouped, one motor to every three or four machines. All motors and pedestal boxes carrying the shafts are set on permanent concrete bases. All the floors in this building are protected by a complete automatic sprinkler system of the "Estey" pattern. All windows are wired glass with "Fenestra" fireproof metal sash.

Following is a list of machine tools on the main floor of the joiners' shop:—24-in. emery wheel tool grinder, automatic, Sagar make; moulding cutter grinder, McDowell make; plane iron grinder; tenoning and scribing machine, Wadkin make; mortising and boring machine, Robinson make; 24-in. circular saw, Robinson; 36-in. circular saw, rising and falling spindle, Robinson; dimension saw (can be set at any angle up to 45 degrees)—Robinson; surface panel planer, facer and edger, Sagar & Company; Universal woodworker and pattern-making machine, Watkin, Scott & King make; spindle moulding machine, four bottom irons removable, Robinson make; band saw, Ransome make; planing and moulding machine, Ransome make; Universal woodworker, boring machine and general joiner, J. A. Fay & Egan; fret saw and boring machine—Robinson; facing lathe for iron or woodworking—Robinson; 12-in. horizontal bed lathe, 16 ft., for wood-working—Robinson; belt and bobbin sander, Sagar & Company; hand power wood trimmers—Oliver Machinery Company.

There is only one machine on individual motor drive in the joiners' shop—the Wadkins Universal Woodworker and pattern-making machine, using a 5 h.p., d.c. Vickers motor. All belting is of leather, wire laced. A complete suction system for removal of waste, shavings, etc., is about to be installed. At the east end of the main floor is located the tool room with grinders and an electric glue melter of 1 gal. capacity and a six-pot electric glue heater, both made by Ransome & Company, London, Eng.

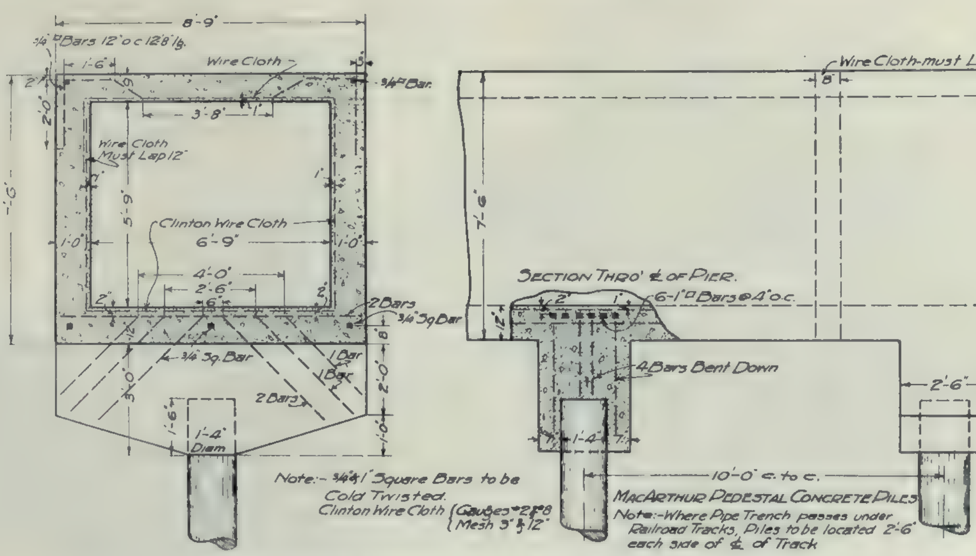
Riggers' Loft.—Beyond the usual riggers' outfit the only machine of interest in this shop at present is a Selby patent, portable, compound, hydraulic cutter, made by Bullivant & Company, London. With this machine two men can cut in 30 sections a steel cable of 7 inches circumference made up of six strands of 12 wires each, 3/16-in. diameter, made of crucible cast steel, hemp core. The ordinary method of cutting such a cable with a hack saw would take one man one hour.

Connected with the joiners' shop at the southwest corner of the building is a heating chamber, 47 ft. x 17 ft. A steam boiler capable of evaporating 5,000 lbs. of water an hour will be placed in this chamber. This boiler supplies steam to the thermotanks for heating the Joiners' Shop and is fitted with a Dutch oven extension furnace for burning refuse from the Joiners' Shop.

Iron-Workers' Shed.—One storey, constructed in three bays, two of which are 500 feet long by 50 feet wide and one 300 feet long by 50 feet wide, with monitor in roof over each bay for full length. General construction—steel frame and roof trusses, brick side walls, concrete foundations on piles. Wooden roof, made of two thicknesses, ⅞-in. T. & G. pine dressed on one side, 5-in. to 8-in. wide laid on timber purlins, 3-in. x 11-in., 3-ft. 3-in. centres, covered with 5-ply tar and gravel roofing, Barrett specification. Windows and monitor sash of steel. Monitor glazing ¼-in. rough cast glass. Window glazing of ordinary 26-oz. glass. Monitor sash controlled by Springer "Simplex" sash operators.

MACHINES IN IRON WORKERS' SHED

The numbers correspond to those shown on layout of this shop. A short description of some of the larger tools is given after the key number:—(1) multiple punch, automatic screw feed, length of travel 30 ft., length of machine 60 ft., capacity 25 holes in plate up to one inch thick at one operation, driven by 30 h.p. Vickers motor. (2) Two radial drills, pillar type, Asquith pattern, served by 5-ton electric crane. (3) 1-in. x 8-ft. combined bending and straightening rolls. (4) 21-ft. plate bending rolls. (5) 1-inch punch and shear (this machine is a combination of three). Punch capacity—1½-in. hole in 1-in. plate, shear capacity, 1-in. plate, manhole punch—will cut in one stroke an opening 23-in. x 16-in. in plates 1-in. thick. This machine is equipped with two 10-ton jib cranes mounted on the frame work. (6) 1½-in. punch, shear and notcher, motor driven, will cut notch or square hole 4-in. x 4½-in. Served by jib cranes attached to frame. (7) 1¼-in. punch and shear (2 punches) motor driven, served by jib cranes attached to frame. (8) two radial countersinking machines, Bertram pattern, vertical spindle attached to wall, 200 r.p.m., belt-driven. (9) 36-ft. planer. With this machine nickel steel plates up to 2-in. in thickness can be planed. The plates are held in place on the table of the machine by twelve hydraulic jacks on top of frame or by twelve screw jacks. The carriage carrying the knives is motor-driven. Travel 36 ft., 30 h.p., d.c. Vickers motor. (10) 36-ft. bending rolls. This is a large and strongly-built machine. Total weight, 240 long tons. Frame-work of double built box girders. Two motors on top frame, for moving rolls, each 40 h.p., d.c. Vickers type. Bottom rolls are 16 inches in diameter and top roll 20-in. Speed of elevating screw on fast gear 4.55 inches per minute. Slow gear 0.38 inches per minute. With this machine, nickel steel up to 2-in. in thickness can be handled. Rolls driven by 200 h.p., d.c. Vickers motor. (11) Roller press, motor 35 h.p., d.c. Vickers. Doxford make. (12) Keel plate bender, hydraulic—will bend cold plates up to 1¼-in. thick—Hugh Smith & Company, makers. (13) Lambie Joggler, hydraulic, 60 tons pressure, single cylinder. (14) Beam bender.



Typical details of reinforced concrete pipe trench—Canadian Vickers plant.

Combination horizontal punch, double angle cutter and beam bender, capacity 6-in. x 6-in. x 1-in. angles, in centre, shape bender and straightener other end; makers, Craig & Donald; motor-driven. (15) Swivel cutter for cutting all kinds of shapes, mounted on turntable, hydraulic worked; the only one of its kind in Canada. (16) 1-in. punch and shear, motor-driven. (17) Fan for supplying blast to beam smiths' fires. (18) Circular cutter (cold friction saw). (19, 20, 21) Three 10-cwt. hammers, pneumatic, Pilkington Company, makers. (22) One 5-cwt. ditto. (23) One two-ton ditto. All hammer, single cylinder. (24) Hydraulic pipe bender, 60 tons pressure, Sir Wm. Arrol & Company, makers. (25) Panel shear. (26) Disc grinder, double, belt-driven, Burton, Griffiths, makers. (27) Hydraulic flange, 60 tons, capable of flanging mild steel plates 4 ft. long by ¼-in. thick; makers, Sir Wm. Arrol & Company. (28) Emery wheel, belt-driven, Churchill make. (29) Band saw, metal cutting, motor-driven; Noble & Lund make; 250 ton hydraulic press for boiler plates, by Hugh Smith & Company. (30) Motor. (31) Circular cutter. (32) Punch and shear, motor-driven. (33) 2-in. pipe screw, belt-driven. (34) 4-ft. bending rolls. (35) 4-in. pipe screw, belt-driven. (36) 6-in. pipe screw, belt-driven. (37) Motor. (38) 5-ft. bending rolls, motor-driven. (39) Radial drill, pillar type, driven by 10 h.p., d.c. Vickers motor. (40) 8-ft. bending rolls, motor-driven. (41) Bevelling machine, motor-driven; Davis & Primrose, makers.

Near the centre of the Iron-Workers' Shed are grouped a bar furnace and plate furnace, with steel stack and blowers, bending slabs of large area and scrieve boards. The furnaces are of the Weardale continuous regenerative type, made by the Dowson & Mason Gas Plant Company, fired by gas from producers. Bending slabs adjoining plate furnaces are of cast iron on concrete walls which form passages under the slabs giving access for cleaning away scale. The scrieve boards are 120 ft. long by 50 ft. wide, made of 6-in. x 2-in. T. & G. pine planks laid on heavy joists embedded in the earth. All machines have been placed on permanent concrete foundations, under some of which concrete piles have been driven.

At the west end of the Iron-Workers' Shed, tools and equipment for smiths, plumbers, coppersmiths and tinsmiths are located. This equipment includes a number of forges all connected with blast and suction pipes. Over each forge is a hood to which the suction pipe is connected. There are six angle smith's forges and eleven smith's forges and six coppersmith's forges —all of the Sturtevant (English) type. The blast fan is a No. 8 Sturtevant (Boston) make, driven by a Vickers 36 h.p., d.c. motor, 1660 r.p.m. The blower fans and motors are in duplicate—one set for standby. Near the north wall in the Beam Smiths' section are two 4-ft. x 4-ft. double pattern "Mecol" forges with hood, by the Mechanical Engineering Company, Montreal. The blast from blowers is driven by a 12 h.p. motor, 1580 r.p.m.

The plumbers and smiths' shops are completely equipped with modern tools. Near the south wall opposite the 2-ton hammer is a large gas-fired reversing regenerative forge furnace of Dowson & Mason make. This hammer and furnace are served by an electric jib crane of 7½ tons capacity. South of the Iron Workers' Shed are located the Gas Producer Plant and Annealing Furnace. At the west end of the building are stores and foremen's offices. The steel stock yards are to the west and north of the building. All parts of the shop are reached by industrial tracks. South of the shop are located platers' boards roofed over and iron workers' tool store, foremen's offices, and air compressor house. In the Compressor House there is a two-stage Canadian Ingersoll-Rand Compressor with a capacity of 2,200 cubic feet per minute at 100 lbs. pressure. This machine is driven by a 3-phase induction motor, b.h.p. 350, 60 cycles, 2,200 volts, 140 r.p.m., Vickers make. There are no overhead travelling cranes in the Iron Workers' Shed. The crane equipment includes three 7½ tons 30 ft. radius, two 7½ tons 25 ft. radius, two 5-tons 25 ft. radius, and one 5-tons 20 ft. radius, all electrically operated, of the jib type, also a large number of hand-power jib cranes, equipped with chain blocks, and all served by a complete system of narrow gauge railway tracks.

Interior of ship berth, showing part of south wall of Basin and Joiners' Shop, Canadian Vickers plant.

Gas Producer Plant.—Duff Pattern, 2 units, burning bituminous slack coal. Rate of gassification per unit, 7½ cwt. per hour; volume of gas 130,000 to 135,000 cubic feet per gross ton of coal. Steam used, about .5 to .6 lbs. per pound of coal consumed. Seventy-five to eighty per cent. efficiency obtained from coal. Seventy-five per cent. guaranteed. Ashes guaranteed not to contain more than forty per cent. of carbon.

The auxiliary steam apparatus consists of a 20 h.p. water tube vertical boiler.

In operating the gas producer plant the coal is fed by hand through hoppers on the charging platform.

The steel stack is 60 feet high, self-supporting, lined with fire brick, 3 ft. 9 in. inside diameter.

The entire plant was manufactured and installed complete by the Dowson & Mason Gas Plant Company, of Birmingham, England.

Ship-Building Berth.—Length over all 500 feet; width over all 132 feet; clear width between columns, 116 feet; height 100 ft. at water end and 80 ft. at shore end. Grade of floor 9/15-in. per foot. Steel frame construction on concrete foundations, and side walls which extend a few feet above grade. The walls proper to within 25 ft. of the roof are of rough glass in sheets 72-in. x 18¼-in. in steel framing of T and angle sections. For a depth of 25 ft. all round the building from the eaves down, the walls are of corrugated galvanized sheeting.

The roof is a double thickness of pine planks, on wooden purlins, covered with 5-ply tar and gravel roofing, Barrett specification. Three hundred and fifty-two concrete piles were driven under column footings and side walls of this building.

In order that work may be carried on continuously, and to prevent damage or delay when vessels are being constructed in the berth, during high water in the spring—caused by freshets or backing up of ice in the river—a movable or "flitch" dam has been constructed across the entire lower end of the berth. The top of this dam will be level with the top of the Basin walls. The foundation of the dam will consist of a mat of concrete 8 ft. deep and 29 ft. wide, properly reinforced. This mat rests on 130 piles. To prevent scouring, a single row of steel piling, of the Carnegie interlocking type, 25 feet long has been driven across the Berth 12-in. back from the outer face of the mat, and the tops of the steel piles have been embedded in the mat itself.

The framing of the dam proper is of steel, composed of standards, or posts, at intervals braced with steel struts. The standards and struts are anchored to the concrete mat. Between the standards 12 in. x 12 in. stop logs or flitches are placed. The whole front or water end of the Berth will be closed in winter by means of portable wooden panels, in angle iron framing. Size of panels 12 ft. 2¾ in. x 11 ft. 6½ in. Number of panels 50. These panels extend from top of dam to bottom chord of end roof truss. For the purpose of handling the panels and the flitches in dam below an I-beam trolley is fitted to the crane girders. The traveller is operated by a hand-power winch.

At the end of the shipbuilding shed are two slipways of timber construction, parallel and spaced 53 feet apart on centres. These ways extend 120 feet outside of the shed.

Across the entire width of the Berth, for the full length of building, 12-in. x 12-in. timbers will be laid on the grade. On these will be laid longitudinal timbers which in turn will carry the keel and bilge blocks and launchways.

The crane equipment in the shipbuilding berth includes four, each of 5 tons capacity 22 ft. 4 in. span, on each side, one of 5-ton capacity 60 ft. span in centre and one of 35 ton capacity 60 ft. span in centre, arranged in such a way that the 35-ton crane can serve the centre of either of two ships under construction side by side. Crane girders are suspended from the roof trusses. All cranes are electrically operated and all were manufactured by Sir Wm. Arrol & Company, Glasgow. Two electric winches are also installed on the slipways.

Administrative Offices of Messrs. Canadian Vickers, Limited.

Power House.—The Power House, Electrical Shop

Gatehouse, Stores and Ambulance Room, Power House and Electrical Shop (to left)—Canadian Vickers plant.

and Test House are all in one building: length 160 ft., width 66 ft., one storey, steel frame construction, brick walls, wooden roof with monitors, concrete foundations on 252 concrete piles. The Power House is 80 ft. long x 66 ft. wide. Tile floor on concrete base. Current is obtained from the Montreal Light, Heat & Power Company at 11,000 volts, transformed to 2,200 volts for supply of induction motors driving air compressors, hydraulic pumps, and fire service pumps and also transformed from 11,000 volts to 315 volts for self-synchronizing rotary converters, of which there are three sets, each 650 kw. speed 720, Vickers make.

There are six induction Vickers motors—two for air compressors each 350 h.p., two for hydraulic pumps each 90 h.p., two for fire service pumps each 250 h.p. General current supply for works motors, of which there are about 200, is 3 wire, direct current at 440 volts and 220 volts for general lighting. The air compressor in this house is the same as that fitted in the shipyard compressor house and is a two-stage Ingersoll-Rand unit, capacity 2,200 cubic feet of air per minute at 100 lbs. pressure, being joined up in common to one large air main through the works. All transformers are of Westinghouse make. The switch gear, both a.c. and d.c., was manufactured by Ferranti Limited, of England. There are two overhead hand-operated travelling cranes, each of 10 tons capacity, 37 feet span, Morris make. The force pumps, hydraulic accumulator and storage tank are located in the Power House. All hydraulic tools are operated from this plant. The force pumps are of the horizontal triple ram type, in parallel, automatically started and stopped by means of solenoid switches so arranged that the driving motors can be run at full speed before loading. The pumps are automatically unloaded before stopping. There are two motor-driven centrifugal lift pumps, connected in parallel, which take water from the river, raising it to the storage tank, lift about 90 feet. The water flows by gravity from the storage tank to the force pumps and is then pumped into the accumulator, in which the ballast on ram, consisting of 179 tons of slag and sand, is raised, maintaining a pressure of 1,500 lbs. per square inch in the hydraulic mains. The hydraulic mains extending to the several buildings are of seamless steel pipe with cast steel oval flanges, manufactured by Stewart & Lloyds, Scotland. The entire hydraulic equipment in the Power House was manufactured by the Leeds Engineering Company, Leeds, England.

The Electrical Shop is equipped as follows: double disc grinder; sheet shears and rolls; wet stone; shaper, radial drill; two screw cutting lathes; large machine lathe; coil taping machine; coil winding machine; band saw for cutting insulating material; hand portable punch.

The machines are belt-driven from line shaft run by a 10 h.p. Vickers motor. In the Electrical Shop is a long work bench equipped with twelve semi-steel solid bar Parker Patent vises.

There is also an impregnating plant for treating field coils, etc., wire and cable storage room and a 3-ton hand-operated travelling crane, 32 feet span, with chain block. The floor is of creosoted blocks on concrete base and the whole shop is protected by "Estey" sprinklers.

The test house is equipped with a horizontal testing machine, capacity 100 tons, used for tension compression and bending tests. This machine was made by Joshua Buckton & Company, Leeds, England.

Administrative Offices.—Located at north-east section of site, facing Notre Dame Street. Three storeys and basement, length 120 ft., width 54 ft., fireproof construction, concrete foundations. Natural ground, no piles required. Steel frame, brick walls. Montreal limestone trimmings. Front and back of building faced with red pressed brick. Floors of "Keystone" gypsum composition reinforced. Partitions of "Keystone" gypsum blocks, wooden roof covered with 5-ply tar and gravel, Barrett specification.

An interior view of the Ironworkers' Shed—Canadian Vickers plant.

The building is divided into three sections. The windows are of the ordinary type. In the east section are located stairways, vaults and chief draughtsman's offices. In the centre the main and draughting offices, and in the west section the offices of the executives, board room, dining rooms, kitchen, etc. The kitchen is on the top floor. On the roof is the sun printing photograph and electric printing frames. The interior trim is of oak and mahogany. The building is heated in winter and cooled in summer by the Carrier Air Conditioning System. A complete air washing plant is installed. The stairways in this building are of ornamental iron manufacture and are installed by the Dominion Architectural Iron Works, Limited. Stair heads are of concrete finished with Toch Bros. dust-proof cement floor paint.

Concrete Piles.—About 3,000 concrete piles of the "Pedestal" type, approximate total length 75,000 lineal feet, were used in the construction of the foundations of the buildings, retaining walls, and heavy machines, the whole of the site being reclaimed ground. The concrete piling was done by the MacArthur Concrete Pile & Foundation Company, of New York. This contract is one of the largest for concrete piles ever awarded in Canada. Each pile is designed to carry a load of 30 tons. Many tests were made under a load of 45 tons and none showed any settlement. All piles were driven to a penetration of 25 blows to 2-in. by a No. 2 Vulcan Steam Hammer, weighing 6,600 pounds; weight of plunger 3,000 lbs., drop of hammer 2 ft. 6 in. Practically all the concrete piles driven are 30 feet in length. Each pile weighs three tons and contains about two cubic yards of concrete.

Two piles were excavated during the course of the work to show the bulb or pedestal as formed by the material when actually in place. One of the accompanying illustrations shows clearly the condition of the piles.

Pile driving was proceeded with during the winter season except when the temperature was below zero. In cold weather the sand and stone were heated by steam. Concrete was mixed in a shed. Wooden covers were placed over the wheelbarrows while the concrete was being conveyed from the mixing shed to the pile-drivers.

Lighting System.—In the Shipbuilding Berth, Iron Workers' Shed and several of the other buildings, mercury vapor lamps of the Westinghouse-Cooper-Hewitt (London, Eng.) type, each of 3,500 c.p. are used. In the Joiners' Shop and around the yard about 150 arc lights of the "Monarch" type, each 600 c.p., made by Verity's Limited, Birmingham, Eng., are installed. All lights are on d.c. circuits, except those for the Administrative Offices and General Store Building.

General Heating System.—All the buildings are heated by Thermotanks, the air taken from the outside of the buildings being passed through the tanks, which contain steam coils of cast iron, by a motor-driven blast fan running at 800 to 1100 r.p.m. and being distributed in the several buildings by means of sheet metal pipes. Registers and controls are placed in the walls and outlets of the pipes. Steam is carried to the tanks from the central heating station through mains in the tunnel except for the Joiners' Shop for which a separate boiler plant has been installed.

Water Supply.—Cast iron water pipes have been extended to all parts of the plant and 22 fire hydrants of the Ludlow non-freezing slide-gate type have been installed. A connection has been made with the city main in Notre Dame Street near the Office Building and also on the river bank. West of the Joiners' Shop a pumping plant is located, the purpose of which is to maintain a pressure of 100 lbs. throughout the mains. Two pumps of Pulsometer Engineering Company's make, driven by Vickers motors of 250 h.p. each, will be installed. Each pump will be capable of delivering 1,500 Imp. gals. a minute against a total head of 350 ft.

Tunnel.—There is a concrete tunnel about 3,000 feet in length, extending from the engine and boiler shop. It is located on the north side of the Fitting-Out Basin around the works to the floating dock on the south side, and connects all the buildings. The inside dimensions of the tunnel are 6 ft. x 6 ft. The bottom and top slabs are of concrete. The top slab is reinforced with Clinton Wire Cloth. For the whole length of the tunnel on 10-ft. centres, heavy concrete girders, resting on concrete piles, have been constructed in the floor slab. The entire tunnel structure is below frost level. Manholes are located at intervals. A typical cross section is shown.

Interior of Electrical Workshop—Canadian Vickers plant.

The tunnel is used for the purpose of carrying water, steam and air mains, and electric cables, a 12-in. cast iron fire service main, 2½-in. hydraulic high pressure main, 5-in. heating main with 4-in. return, 8-in. compressed air main, 4-in. drinking water main, 10-in. steam main, at 200 lbs. per square inch to Engine Shop for testing steam turbines. All electric cables will be supported on porcelain insulators.

Pneumatic Equipment & Tools.—Two Compressors, Canadian Ingersoll-Rand Company's make, one in Compressor House and one in Power House, of capacity already given, connecting to a common 8-in. main which completely encircles the works, with branches to each shop and department, have been installed. In particular the floating dock has 240 connections, and the ship berth 300 connections. The pneumatic and electric tools used throughout the works were manufactured by the Chicago Pneumatic Tool Company.

New Boyer Rivetting Hammers Nos. 60-80 and 90 are being used in conjunction with Boyer standard Short Holders-on and Boyer Combination Holders-on for driving rivets in boiler plate and for general work of this nature. Special Short No. 50 Boyer Rivetting Hammer with inverted handle is being used for rivetting in the bows of boats where space is limited.

Interior of Joiners' Shop—Canadian Vickers plant.

"New" Boyer and "New" Chicago Chipping Hammers are being used for chipping steel along the edges of plates when required, and for caulking and general work. The "F" Boyer Hammer is used for chipping paint and scaling off the sides of boats which are to be repaired. "Little Giant" Pneumatic drills are being used for all metal boring including reaming of holes of different sizes for bolts, etc. "Little Giant" Wood-Boring machines are used for boring holes in timbers for the dock. No. 2 Boyer Rivet Buster is being used for breaking the heads of rivets condemned by inspectors. "Duntley" Electric Drills, all sizes, from the Midget drill to No. 3, are being used in drilling in all parts of the plant where air is not available. "Protector" brand hose, with woven steel armor for water, steam and air, is in use throughout the works, also a special large air hose with cotton jacket of "Protector" brand, is used for carrying compressed air from the air main to the Floating Dock. All hose was manufactured by the Woven Steel Hose & Rubber Company, Trenton, N.J.

The pneumatic and electric tools and hose above described were supplied to the Canadian Vickers Company by the Holden Company, Limited, of Montreal.

Central Heating Station.—One-storey building, 136 ft. long x 50 ft. wide, steel frame, brick walls, concrete foundation on concrete piles, mill roof 2 in. x 4 in. on edge covered with 5-ply tar and gravel roofing, Barrett specification, metal window frames. Central heating, station includes boiler plant, steam test house, economizer, conveyors, radial brick stack (Alphonse Custodis make) 175 ft. high.

The equipment includes four Babcock-Wilcox water tube boilers, 200 lbs. pressure, each having a heating surface of 3,720 sq. ft., used for heating purposes in conjunction with the thermotanks, and one boiler of similar make and capacity, pressure 320 lbs., for testing purposes. Green's economizer and chain grate stokers, coal breaker, ash handling plant, coal conveyors, capacity 40 tons per hour, all of Babcock-Wilcox make, are also installed.

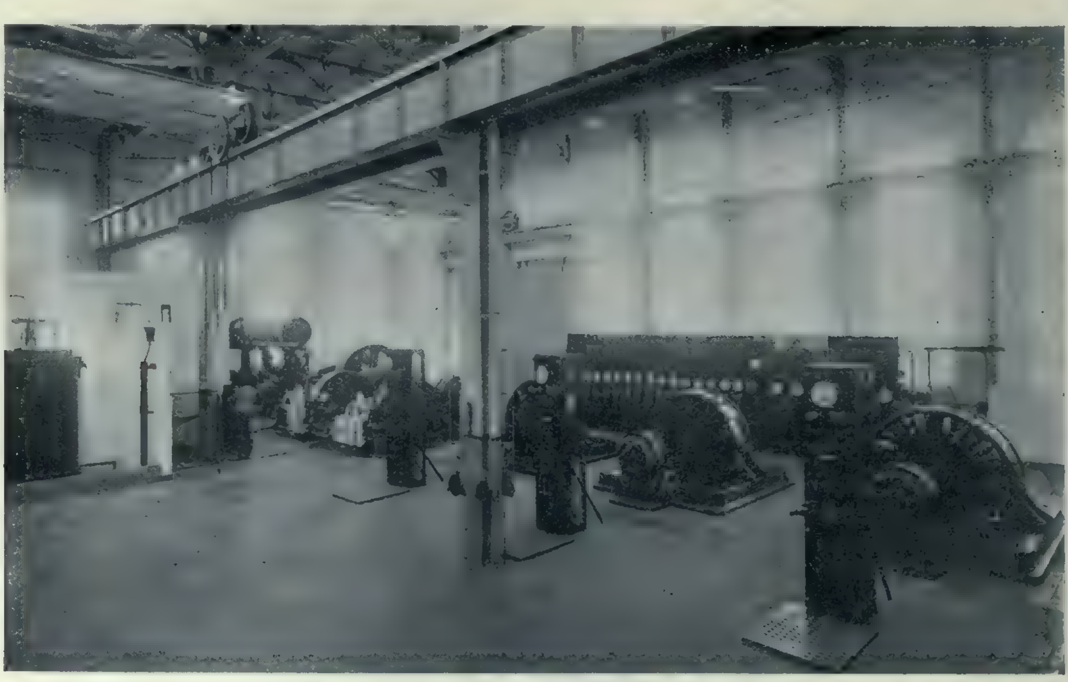
The five boilers together are to be capable of evaporating, when burning 20 lbs. of slack coal per sq. ft. of grate with natural draft, 64,000 lbs. of water an hour.

Integral steam superheaters, each having 572 sq. ft. of heating surface, one on each boiler, each superheater to be capable of imparting 150 degrees Fahr. superheat to the steam produced by one boiler. The chain grate stokers, automatic, Babcock-Wilcox type, are to be capable of burning coal, containing 30 per cent. of hydro-carbon and approximately 13,000 b.t.u. per pound of dry coal, smokelessly, and well within the requirements as regards smoke nuisance.

All valves and headers in boiler plants are of cast steel.

General Stores, Gate House and Ambulance Room.—Size of building 103 ft. long x 34 ft. wide, two storeys and basement. Steel frame, brick walls, concrete foundation on 88 concrete piles. Reinforced concrete floors designed to carry 400 lbs. per sq. ft. Reinforced concrete roof slab 4½ in. thick, on steel purlins. Ordinary windows.

Dartnell, Limited, contracted for the waterproofing of this building. The well-known waterproofing compound manufactured by the R. T. W. Damp Resisting Paint Company (Toch Bros.), was mixed integrally with the concrete in the side walls and lower floors, and a 1-in. surface coat of cement mortar made with the compound covers all exposed parts of the concrete. The lower floors are dust-proofed with Toch Bros.' filler. The building is fireproof. An Otis-Fensom Freight Elevator in wired glass fireproof enclosure is installed. The building is located at the main entrance gate of the works and in it there will be the gate office, general stores, ambulance and first aid equipment.


Interior of Power House—Canadian Vickers plant.

Engine and Boiler Shops, and Brass Foundry.—Located in one building, size—length 380 ft., width 155 ft., height 38 ft. to bottom of roof trusses. Steel frame construction, brick walls, concrete foundations on concrete piles, wooden roof covered with 5-ply tar and gravel roofing, Barrett specification. The building is divided longitudinally into three bays; widths 65 ft., 51 ft. and 39 ft. Above the narrow bay is a gallery 310 ft. long. On this gallery will be located a turbine blade workshop, blading template floor, blade assembly benches, lockers for assorted blades, etc.

The west half of the building will be used as a Boiler Shop. This space is divided into three sections for boiler work, machine work and erecting. The Engine Shop will occupy the east half of the building. Two lines of standard gauge tracks will be extended through the shops. In the Engine and Boiler Shops there will be three 25-ton and one 5-ton overhead travelling cranes. All cranes are of the plate girder type electrically operated, designed and manufactured by Sir William Arrol & Company.

At the north-east corner of the Engine Shop is a brass foundry 60 ft. x 40 ft., one storey. In this foundry there will be six pot fires, emery wheel, drying store, sand shed, metal shed and coke storage.

Following is a list of machine tools and equipment in the Boiler and Engine Shops: duplex radial drill; six spindle multiple drill; elliptical hole boring machine; plate edge planing machine; thermotank, fans and motors; 24-in. double head shaping machine; pipe drilling and facing machine; "Johns" splitting shears; horizontal plate bending rolls; vertical hydraulic plate bending machine; one fixed hydraulic riveting machine; tube cutting machine; circular saw; tool grinders; screw cutting machine, levelling block; smiths' hearth; testing machine; hydraulic intensifier electro-depositing bath; motor and generator; acid pickling bath; soda washing bath; 72-in. x 72-in. x 14-ft. planing machine; compound planing machine; turbine boring machine; horizontal drilling machine, 5-in. spindle; horizontal drilling machine, 3-in. spindle; duplex radial drills; vertical drill; 5-ft. 6-in. radial drill; 72-in. turbine lathe; 36-in. duplex lathe, double header; 8-ft. chuck lathe; 14¼-in. gap lathe; 12-in. gap lathe; 36-in. circular planer; two No. 3 facing and boring machines; turret lathe; capstan lathe; profile milling machine; Universal milling machine; vertical milling machine; 24-in. double head shaper; 12-in. slotting machine; 24-in. slotting machine; wormwheel generator; bevel gear planer; screwing machine; band saw; portable milling machine; saw sharpening machine; saw setting machine; Keyway cutting machine; 28-in. disc grinder; tool grinder; sensitive drill; No. 2 facing and boring machine; 8½-in. brass finishers' lathe; 6½-in. capstan lathe; 12-in. gap lathe; 9-in. capstan lathe; 5-ft. radial drill; horizontal drilling machine; semi-automatic duplex milling machine; 24-in. shaping machine; 8-in. slotting machine; tool grinder; turbine blade press; screw press; turbine blade sawing machine; turbine blade knicking machine; No. 1 turbine blade tipping machine; No. 2 turbine blade tipping machine; turbine blade drilling machine; turbine blade rumbling machine; section washing tank; 20-in. disc grinders; sensitive drill; flanging press and furnace.

The largest machine in the engine shop is a 36-in. double duplex patent lathe used for machining marine shafts, etc. Length of bed 113 ft., 4 carriages, 2 head stocks, 2 tail stocks, each pair driven by a 52 h.p., d.c. motor, 320 to 960 r.p.m. Vickers type. The length of foundation of this lathe is 120 ft.

Sir William Arrol & Company, Limited, engineers, are responsible for the design of the buildings. Messrs. T. Pringle & Son, Limited, Engineers, Montreal, designed the Administrative Offices, Gate House and Central Heating Station to the requirements of the Canadian Vickers, Limited.

The general contractors for the construction of the plant above described are E. G. M. Cape & Company, Limited. Following is a list of the sub-contractors for the construction work:—MacArthur Concrete Pile & Foundation Company, New York, concrete piling; Keystone Fireproofing Company, Limited, New York, fireproofing; Alphonse Custodis Chimney and Construction Company, New York, brick chimney; Robert Reid, Montreal, floor and tile work, granite; Hadrian Flooring Company, Limited, Montreal; floor and tile work; Douglas Bros., Limited, Montreal, kalameined work; Wm. Rutherford & Sons Co., Ltd., Montreal, millwork; F. Tremblay & Co., Ltd., Montreal, millwork; U. Pauze & Fils Co., Montreal, millwork; Dominion Architectural Iron Works, Ltd., Montreal, ornamental iron work; Canada Creosoting Co., Ltd., Toronto, paving blocks for floors; P. J. Sullivan & Co., Ltd., Montreal, plumbing and heating; Thomas O'Connell, Montreal, plumbing and heating; Trussed Concrete Steel Co., Montreal, reinforced steel; Dominion Bridge Co., Ltd., Montreal, steel work; Structural Steel Co., Ltd., Montreal, steel work; Phoenix Bridge & Iron Works, Ltd., Montreal, steel work; Steel & Radiation, Ltd., Montreal, steel sash; G. W. Reed & Co., Ltd., Montreal, waterproofing; Dartnell Ltd., Montreal, waterproofing; Francis Hankin & Co., Ltd., Montreal, waterproofing; Geo. W. Reed & Co., Ltd., Montreal, roofing; Richardson & Simard, Montreal, roofing; Metal Shingle & Siding Co., Ltd., Montreal, roofing; Canadian H. W. Johns-Manville Co., Montreal, roofing; Sibley & Huot, Montreal, roofing; Master Builders Co., Montreal, flooring; Pedlar People Ltd., Montreal (Oshawa), reinforcing, Clinton wire cloth; Sherwin Williams Co., Montreal, paint; LaPrairie Brick Co., Ltd., Montreal, brick; Canada Cement Co., Ltd., Montreal, cement.

Fireproof partitions in the offices of Messrs. Canadian Vickers, Limited.

Ahern Safe Company, Montreal, safes; Sir Wm.

Arrol Company, Glasgow, heavy cranes, hydraulic presses, etc.; Babcock & Wilcox, Limited, Montreal, boilers and auxiliary equipment; John Bertram & Sons, Dundas, radial drills; British Westinghouse Co., London, Eng., Cooper-Hewitt mercury vapor lamps; Brown Hoisting Machinery Company, Cleveland, locomotive cranes; Canadian Fairbanks-Morse Co., Montreal, "Byers" pipe; Canadian Ingersoll-Rand Co., Montreal, compressors; Carrier Air Conditioning Co., New York, office ventilation and heating; Chicago Pneumatic Tool Co., Chicago, pneumatic and electric tools; Dowson & Mason Gas Plant Co., England, gas producers and furnaces; Ferranti Electrical Co., Toronto, panels; Holden Co., Limited, Montreal, pneumatic tools and armoured hose; Leeds Engineering Company, Leeds, Eng., hydraulic accumulator and ram; Ludlow Manufacturing Co., Troy, N. Y., fire hydrants; MacArthur Concrete Pipe & Foundation Co., 11 Pine Street, New York, concrete piling; D. K. McLaren Limited, Montreal, belting; Morris Crane & Hoist Co., Ltd., England, chain block and travelling cranes; Office Equipment Co. of Canada, Montreal, furniture and office equipment; Otis-Fensom Elevator Co., Ltd., Montreal, freight elevators; C. Parker Company, Meriden, Ct., patent vises in electrical shop; Paterson Manufacturing Co., Toronto, roofing materials; P. Pilkington & Co., England, pneumatic hammers; Pulsometer Engineering Co., Reading, England, pumps; Hugh Smith & Sons Co., Glasgow, bending rolls, etc.; Springer Lock Co., Belleville, monitor sash operators; Stewarts & Lloyds, Glasgow, steel high pressure pipe; B. C. Sturtevant Co., Boston, blowers; Sturtevant Engineering Co., Ltd., England, forges, fans, blowers, etc.; Thermotank Ventilating Co., Glasgow, heating system in all buildings; Vogel Co. of Canada, Ltd. (Estey Bros.), Montreal, fire sprinklers; Woven Steel Hose & Rubber Co., Trenton, N.J., armoured hose; Toch Bros., New York City.

Marsh & Henthorn, Limited, Belleville, state that large quantities of boiler tubes are needed in Canada and express their belief that there is good opportunity for the establishment of a boiler tube factory, as tubes now used are practically all imported from the United States, Germany and Belgium.

Concrete Piles for the Canadian-Vickers Plant

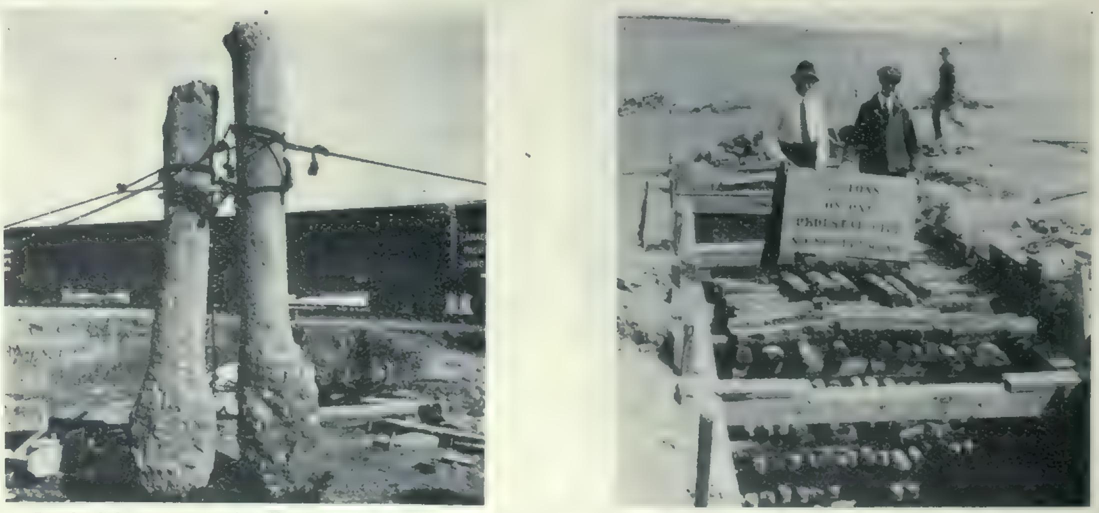
AFTER exhaustive inquiries and inspection of different types of foundations the Engineers of the Canadian-Vickers Company, aided by the experience of the general contractor, Mr. E. G. M. Cape, of Montreal, it was decided to award the various contracts, seven in all, for the foundations to the MacArthur Concrete Pile and Foundation Company, of New York, Ottawa, etc. It was judged that the enlarged base of the Pedestal Pile, the exclusive product of this company, resting on the original sea bottom would be eminently suitable for the solving of the foundation problem, while their heavy steel driving apparatus would serve the purpose of either displacing or shattering the large boulders which would inevitably be encountered. The foundation plans gave an ultimate load of thirty-two tons per mile. The various contracts awarded to the MacArthur Company were as follows:

Number of piles	Lineal feet	Buildings
66	1,991	Import stores.
747	16,857	Ship berth and retaining wall.
619	16,533	Joiners' shop, iron workers' shed, power house and electrical shop.
635	19,003	Engineer shop and boiler shop.
123	3,513	Gate house and machine foundry.
382	6,774	Central heating station and tunnel.
36	1,038	Machine foundation in boiler and machine shops.

7 contracts 2,608 piles 65,709 lineal feet.

While these contracts did not run continuously, owing to delay in reclaiming the land, the MacArthur Company were occupied for one year and seven weeks in all on this work.

The judgment of the engineers was fully justified by results. Fourteen piles were picked out at random and loaded with forty-two tons each under the



On the left, concrete piles, "Pedestal" type, excavated to show formation of bulb. On the right, one of fourteen tests made by the MacArthur Concrete Pile & Foundation Company.

supervision of the owners' engineers. The results of the tests were as follows:

Length of pile	Number of hours load remained on	Final settlement in feet
22 ft.	48	.006
24 ft.	48	.008
20 ft.	48	.010
32 ft.	48	.010
18 ft.	48	.006
31 ft.	48	.006
28 ft.	48	.007
30 ft.	40	.007
29 ft.	24	.004
26 ft.	24	.008
28 ft.	48	.019
27 ft.	48	.007
27 ft.	96	.001
26 ft.	96	.000

Hydrated Lime in Concrete

HYDRATED lime as an adjunct to portland-cement mortar and concrete is no new thing. Various well-known experimenters have shown that small additions of hydrated lime to cement mortars render them practically impermeable to moisture, have no material effect upon their tensile strength and much increase the plasticity of the mortar over that composed of cement and sand alone.

These very commendable characteristics of hydrated lime have been accepted by engineers without much thought as to their application to concrete work. In fact, the makers of hydrated lime, themselves, have not considered it worth while to emphasize any of them except the waterproofing feature, which is unfortunate from a selling view point, because there are many other equally effective ways of making concrete watertight. It is doubtful, however, if one engineer in twenty, accustomed to the use of concrete, has an adequate appreciation of the possibilities of hydrated lime, due to those very qualities upon which many experimenters have reported.

In two fields of concrete work there would appear to be a distinct advantage in using hydrated lime; in concrete which is to be delivered by the spouting method and in concrete roads. In the former case it has long been a cause for complaint that while spouting is a most, perhaps the most, economical and effective way of getting concrete to the forms, unless the tower is exceedingly high or the radius of deposition quite short, the low angle of slope requires an excessively wet concrete to insure easy spouting, and every experimenter knows that an excessively wet concrete is a dangerous concrete. It seems probable, however, that a proper admixture of hydrated lime would give the concrete a "buttery" consistency, a certain slipperiness, as it were, which would lower its friction coefficient and permit of its spouting on a lower slope.

The desirability of hydrated lime for concrete road work was well advocated at the recent Road Congress at Atlanta by a lime manufacturer, Charles Warner, of Wilmington, Del. A point in favor of the use of lime in road concrete emphasized by Mr. Warner is the effect of the hydrated lime in reducing the tendency to segregation in the wet mixture of cement, sand and stone, and also in reducing the ratio of the expansion when the concrete changes from a dry condition to a wet condition. This reduced expansion is doubtless a result of the decreased permeability of the concrete made with hydrated lime. The importance of reducing segregation ought to be apparent without argument. One of the difficult things in laying a concrete road is to get the mix wet enough so that it can be readily tamped into place and will form a solid mass without voids and yet not so wet that the cement and sand will separate as the water flushes to the surface. The addition of hydrated lime materially decreases the tendency of the cement and sand to separate under the screed or the trowel, and at the same time makes the mass flow more readily into place.

It might be thought that mixing the lime with the cement, even though it did not affect the tensile strength of the mortar, might alter its hardness, since lime-mortar is much softer than cement. Since there is no place in which concrete is used where extreme hardness and resistance to concussion and abrasion are of greater importance than in a concrete road surface, the probable wear of a hydrated-lime concrete road is equally important as the ease of construction. Here is something that experience alone can answer. We are informed that at least one concrete road is this year under construction with the admixture of hydrated lime. Its behaviour will be watched with interest by engineers.

Of course, it can readily be understood that the hydrated lime must be very thoroughly mixed with the cement to secure the results above set forth. If such thorough mixing is not secured and some parts of the mortar as laid in the completed work have a deficiency of hydrated lime while others have an excess, the strength of the work might be considerably affected. The question how practically to effect such thorough mixing is not as easy as might at first sight appear. Where mortar alone is to be used and the machine mixer is available, it will be comparatively easy to put the right proportion of hydrated lime in each batch and keep the mixer turning until the lime, cement and sand are thoroughly incorporated. The great bulk of portland cement, however, is used in making concrete and the accurate proportioning of the lime to the cement and its thorough mixing with the stone and sand are matters deserving some study.

Indeed, practically all of the advantageous features set forth above have had only limited practical proof. Theoretically and experimentally there is much to be said in favor of the proper use of hydrated lime in concrete. Therefore engineers will look for reports on the actual construction which the next year will undoubtedly bring forth.—Engineering News.

An Important Contract on the Vickers Plant

Messrs. Dartnell, Limited, were awarded the contract for waterproofing the hydraulic press pit and foundations for Canadian Vickers, Limited, an extended description of whose plant is a feature of this issue. The work was done with a 1-in. waterproof plaster coat, with 2 per cent. "Toxement." The floor also received a 1-in. plaster coat, the operations being identical with those carried out on Messrs. Dartnell's contract for the gatehouse. It is of interest to note that in the waterproofing of the pump-house, which was carried out by Messrs. E. G. M. Cape & Company, Limited, general contractors, 2 per cent. of "Toxement" was employed. This pump-house is on the water edge of the St. Lawrence and stands a head pressure of 20 ft. The absolute water-tightness of this work is guaranteed by Messrs. Dartnell, Limited, for a period of five years.

The New Sewage Disposal Plant at Aberdeen, S.D.*

Details of Design, Construction, Operation and Cost, with Points of Practical Interest brought out in a Discussion of the System

PART II. (Conclusion)†

By W. G. Potter

All concrete was composed of Northwestern States Portland cement and pit-run Kampeska gravel, in proportions varying from 1 to 4½ to 1 to 6. This gravel was taken from below the water of Lake Kampeska, about 100 miles from Aberdeen, and is remarkably free from dirt or other foreign material. It made a very dense and solid concrete.

In construction a 35 ft. tower was erected between the main sedimentation tank and the sludge filter, and all concrete for these and for the siphon tanks was spouted from the tower to position. Gravel and cement were brought to the mixer by Koppel cars. The concrete was raised in the tower, and the gravel was drawn up an incline to a pocket above the mixer by the use of one team.

For the sprinkling filter and the final tank, the mixer was erected along the railroad spur, and all gravel was shovelled direct from the railroad car to the mixer. The concrete was run from the mixer into Koppel cars on 24-in. gauge tracks, and pushed by hand to the place of dumping. The crushed stone for the filters, of which 175 carloads were used, was unloaded mostly by rigging up a block and tackle so that a drag-scraper could be pulled lengthwise of the car, dumping at the end over a trap into a Koppel car beneath. This arrangement cut the cost of unloading and moving the stone into position by about 50 per cent. from unloading by hand.

Labor was paid 22½c. per hour at first, followed for the most of the work by 25c. per hour, and was very hard to get during the summer and fall seasons. Form carpenters were paid from 35c. to 45c. per hour and brick masons from 70c. to 80c. per hour.

The total cost of the plant will be about $130,000, of which about $20,000 will be for reconstruction of the pump house and its new machinery, $9,000 for land and right-of-way costs, about $20,000 for the force main, $17,000 for crushed stone, and the balance for concrete materials, labor, etc. The bond issue for this work was $200,000, so that there is an unexpended balance of $70,000.

Sewage was started through the new plant about April 1st, but it will still be some time before the changes in the pump station are complete.

The entire work, excepting part of the excavation, part of the pipe hauling, and the construction of the pump house building above the foundation, was done for the Commissioners of the city of Aberdeen by city forces without contract, the writer being the designing and constructing engineer, and W. D. Northen, of Chicago, the general foreman. Most of the changes of machinery in the pump station were made by Mr. W. F. Hoberton, Supt. of Water and Sewer. It is a good example of non-political municipal work, and the writer is very glad to say that politics was one of the incidental troubles that was entirely absent from this work.

Discussion

W. D. Gerber (Chairman): One of the principal points of interest in connection with this plant at Aberdeen is, I believe, the fact that it was designed by a special engineer (the author of the paper presented this evening) employed for that purpose, and constructed on a force account basis by the City. This is rather a departure from the general practice.

The Author: Changes in the pumping station are still being made, and because of the operation of the pumps the work is proceeding very slowly. It will probably be another month before the changes are completed. The cost of concrete work ran from $3.25 for the concrete floor in the sprinkling filter up to about $8.25 on part of the reinforced work. The cost of unloading stone in the sprinkling filter at first ran from 45c. to 60c. per yard. Later we were able to cut it down to 19c. to 24c. per yard by working the drag scraper lengthwise of the car and dumping through a trap into Koppel cars. Most of the cars used were gondolas. The average final cost was about 32.4c. for unloading stone from the cars and putting it in place in the filter.

Mr. Gerber: The construction of such a plant is an interesting problem, and one that usually requires special consideration. I think perhaps Mr. Sherman can give us some points on constructing concrete work of this character.

L. K. Sherman: The plant at Aberdeen furnishes two interesting features. One of them is the location of a sprinkling plant so far north, where provision had to be made for an extremely low temperature. We shall be interested to learn the future results. The other interesting feature is that to-day the people themselves are taking a higher view of necessities and requirements. We have been accustomed to thinking that sewage disposal plants were forced upon us by community growth; in other words, where the population became dense, we took care of the situation by building a plant to prevent being a nuisance to our neighbors. That we have advanced and will not put up with what we did twenty years ago in the line of sanitation is exemplified, I think, in this plant at Aberdeen. We have also become more rational in our views regarding sewage disposal. Some time ago, in speaking of sewage disposal, we said "sewage purification." Nowadays, all prominent men in sanitation work speak of it as sewage treatment. They have helped the cause of sewage disposal in not leading the layman to expect from sewage plants that which he cannot get. The efficiency of the work done at Aberdeen is worthy of especial note. I am not prepared to say whether contractors would have built the plant cheaper than Mr. Potter did, but it looks as though the work was done very reasonably. The use of the siding for unloading cars was ingenious and I have not seen this done elsewhere. The concrete tower is, of course, standard practice. In Mr. Potter's design, the sludge pipes do not extend from the valve to the surface, as is the general practice. As I understand it, the reason sludge pipes are generally run close to the top with an opening is so that a stick may be poked down, expecting that the pipe may clog. I have never heard of the use of a stick being necessary, and I do not know that the pipes do clog, but this is the first plant I have noticed in which that feature has been omitted.

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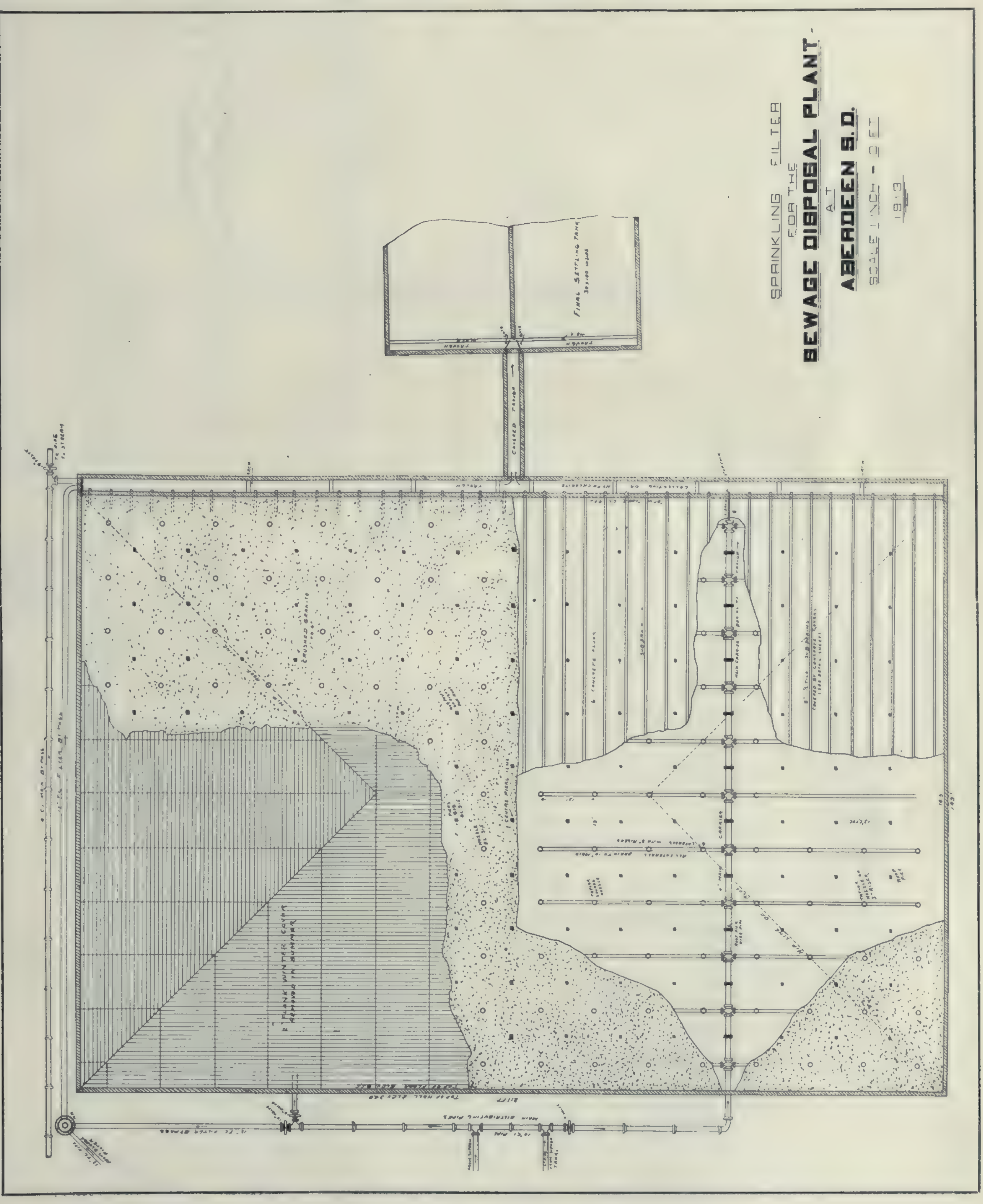
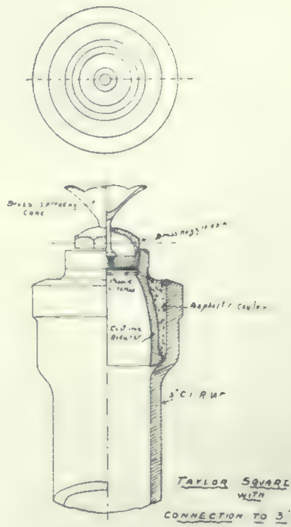
*Paper presented before the Hydraulic, Sanitary and Municipal Section of the Western Society of Engineers.

†Part I. was published in our last issue.

Mr. Gerber: The point Mr. Sherman brought up in regard to the design of sludge pipes is a good one. The feature doesn't cost much, and in this respect it is like a good many other precautions. A man, for instance, will carry accident insurance, and yet may never have an accident. The device may never be used, but if we want it, we want it badly.

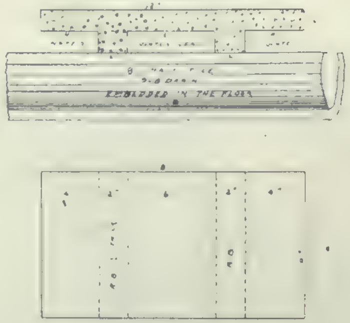


DETAIL SHEET
FOR THE
SEWAGE DISPOSAL PLANT
AT
ABERDEEN S. D.
1913



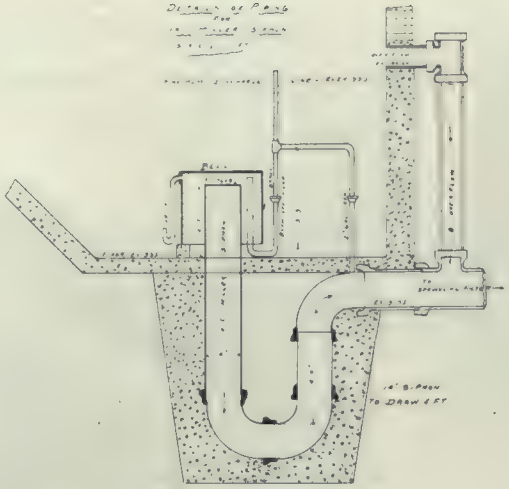
TAYLOR SQUARE NOZZLE
WITH
CONNECTION TO 3" C I RISER
ONE HALF SIZE

CONCRETE COVER
FOR
FILTER SUBDRAINS

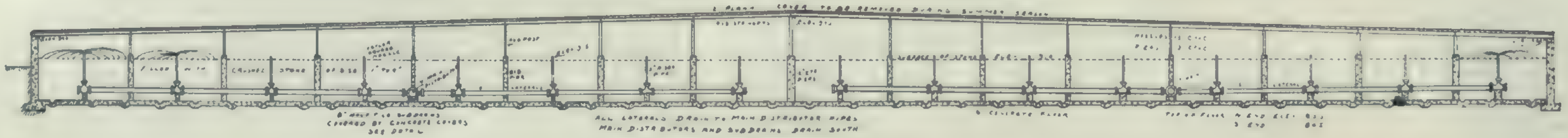


PLAN OF COVER

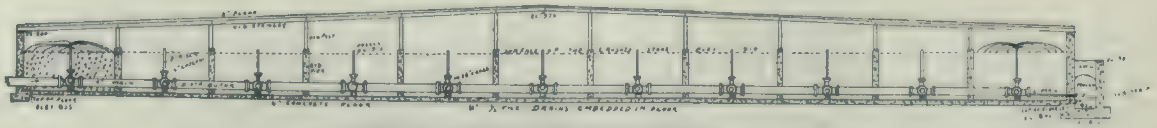
DETAIL OF POND
FOR
10" MILLER SIPHON



Fill Both Main & Blow off Traps with Water
Before Putting Siphon into Operation
Do not ... outside of Bell


All Laterals Drain to Main Distributor Pipes
Main Distributors and Subdrains Drain South
Concrete Floor

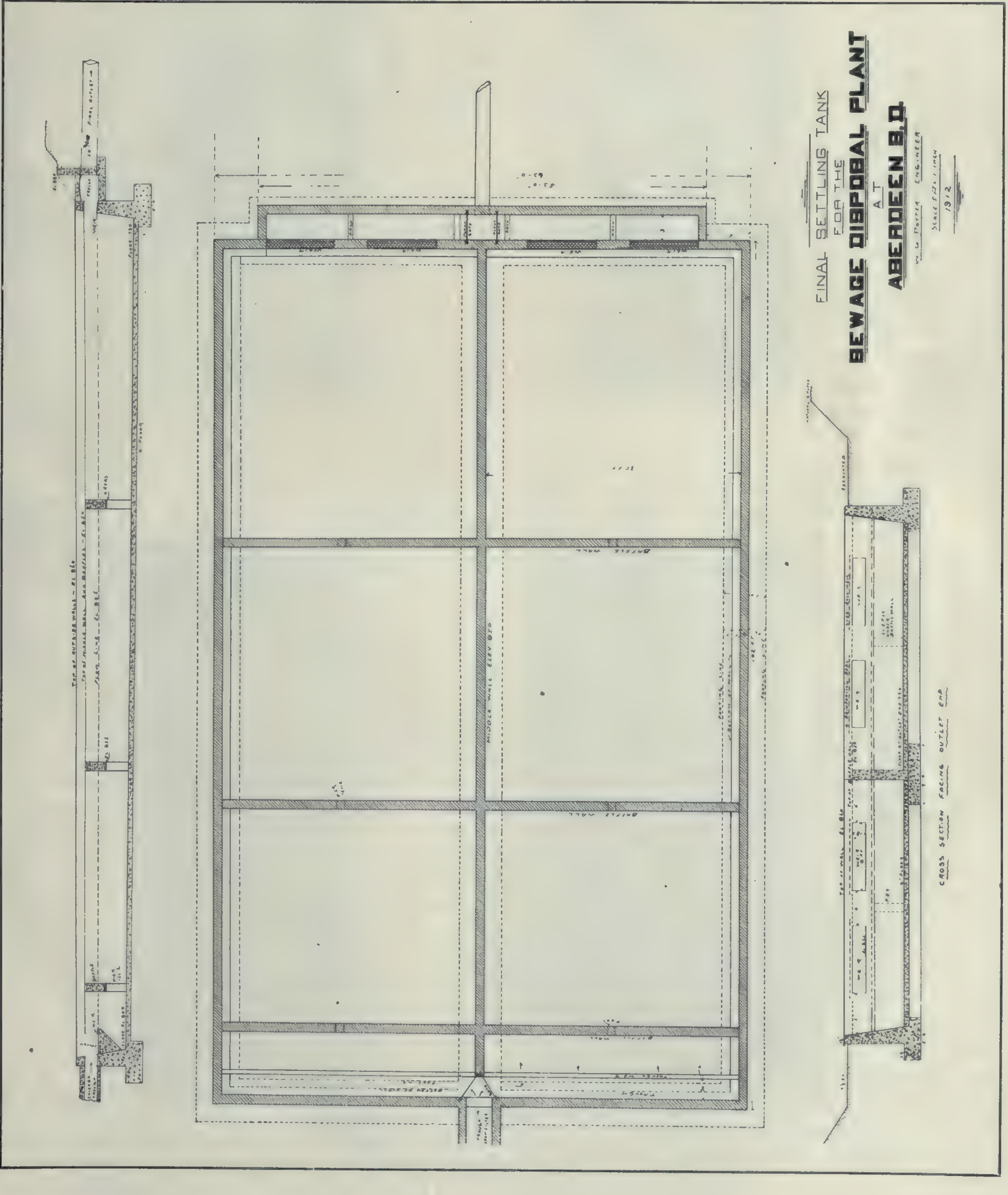
CROSS SECTION OF SPRINKLING FILTER



LONGITUDINAL SECTION OF SPRINKLING FILTER

The Author: Mr. Sherman called attention to the sprinkling filter being used so far north. There are a number of sprinkling filter plants used in Saskatchewan and Alberta, but they are inclosed in buildings. In the case of the plant at Aberdeen, we have merely a temporary winter cover, which is taken off in the warmer season. They have several sprinkling filter plants of the English type, and disposal plants, in Canada, some of which have been running for the past two years, which I think have done very well. I am expecting to get considerable information from Aberdeen this coming winter in regard to that plant, and also in regard to plants in the extreme North.

Langdon Pearse: The author shows that the expenditure was about $130,000 for 12,000 people. Were 12,000 people actually connected to sewers? Also, it would be interesting if the author would give us the itemized cost, distinguishing the cost of settling basins, sprinkling filters, secondary tanks, and sludge tanks, showing the distribution of costs as compared with other plants. What I would like to know particularly, is whether, for instance, the settling plant



cost $35,000, the sedimentaion tank $10,000, and the sludge tank $2,000. Something in that general way would be very instructive. I have sought data available on such works in connection with our investigations for the Sanitary District and have found considerable variation of cost throughout the country. For instance, costs based on census figures do not agree with the figures covering material actually handled, per capita; the figures will run three times as high for some places as for others. I would also ask the author whether he had any difficulty in forming the sloping walls and baffles of the settling chamber in the sedimentation tank.

The Author: The sprinkling filter cost $35,000, including the rock in place. The rock amounted to 5,500 cu. yds. The rock cost was $2.96 per cu. yd. f.o.b. cars. The cost of unloading including placing was about 32c. The sedimentation tank cost $13,000. These figures are approximate only. The siphon tank cost $1,500. The sludge tank cost about $2,000. The final tank cost about $4,000. In connection with the building of the final tank we had considerable water to contend with. The pumping station, including new machinery and changing the position of the old machinery, cost $25,000. The land cost amounted to $9,000 for 80 acres, of which about three acres are in use. There was considerable general work. For instance, we had a good deal of dirt to excavate. Then there were the two dams, the by-passes, the attendant's house, and such things, that could not be included in the cost of any one of these different parts, but still were included in the total cost. The inclined walls were about 8 ins. thick, built of plain concrete. They were built by making a form for the pocket; on account of its weight, we cut the form in two, horizontally, and handled each half by means of a derrick; we put the entire form in place for each pocket, concreted the pocket, pulled the form out, and used it for the next. We had no trouble whatever in building the walls.

Mr. Sherman: I recently constructed some of these baffle walls where the situation was very much cramped, and the forms could not be taken out after they were once in place. We built them in sectional slabs, on the ground, with expanded metal. We poured mortar on the slabs and let them lie on the ground, with a part of the expanded metal protruding at the ends. When the slabs were assembled, mortar was poured over the metal which protruded, and the whole became bonded together. The method proved a successful one, and much more economical than building the walls in place and setting forms on both sides.

The Author: Form work is expensive, on sedimentation tanks especially, not only as regards cost of material, but for labor.

Mr. Gerber: There are two points brought out in this discussion on which I might give our experience. The first one is that of extending the sludge pipe above the water line. About the year 1901 we built a plain septic tank of the old flat bottom type. The man in charge was very conscientious and I was able to get from him a great many points in regard to his experience in the handling of the sludge. According to this gentleman, sludge which was allowed to stand for a period of six months or more was extremely difficult to pump on account of the compactness of the deposit. It was also his experience that it was necessary to periodically remove the scum or mat which formed on the surface of the so-called digestion chambers, for the reason that if this mat was allowed to stand and become ripe and settle to the bottom of the tank, it formed a sort of gummy mass that became almost impossible to handle even with an 8-in. centrifugal pump. He stated to me that he was able to tell purely from observation when the mat was about ripe and it was his practice to skim it off at these times. When the scum was thus prevented from settling to the bottom of the tank, it was found that the sludge proper could be very readily handled by the pump and that it did not set up so densely as when the scum was not removed. In another plant which has only been in service two years it was possible to provide sludge pipes with the discharge 5 ft. below the water line in the tank; the vertical portion of the sludge pipe was not carried above the water line. After the tank had been in service about a year an attempt was made to clean out the sludge pockets, and we found that the sludge had settled in so tightly that it did not move under the action of the 5 ft. head. It was necessary to install a pump and draw down the liquid in the tank to below the level of the discharge line of the sludge pipe. The elbow was tapped out to provide for the insertion of a 1-in. pipe nozzle. By putting water pressure on this nozzle we were able to jet the compacted sludge away from the bell mouth of the sludge pipe and get the action we desired. Since this experience, our practice has been to carry the sludge pipes above the flow line. The question of removing the forms for the casting of inclined walls in the tank proved a rather serious problem in one of our recent designs, and to obviate this difficulty we provided reinforced rectangular beams on which were placed reinforced concrete slabs 2 ins. thick. These slabs could be placed from above and when so placed were grouted in with cement mortar. About the only difference between our construction and that referred to by Mr. Sherman is that each was separate and the reinforcing was not allowed to extend beyond each individual slab.

W. W. DeBerard: It may be of interest to know that in California they have recently changed two septic tanks at Orange into shallow Imhoff tanks. This was done with the idea that it would be an experiment, so redwood was used for the baffles and flowing-through troughs. If successful, they are to be reconstructed in a more substantial manner. The tanks were 70 ft . long, 10 ft. wide, and 7 ft. sewage depth, and were entirely covered over with a concrete roof. There was no means of getting into these tanks, and five holes had to be cut through the top of each tank. So as to make the hanging baffle walls remove the sludge and to keep the sludge from running lengthwise, tight cross partitions were constructed every 14 ft. On the bottom of the floor was laid a sort of underdrain system of vitrified pipe with thirty holes. It drained into a single pipe line and each compartment was controlled by a valve. Prof. Charles Gilman Hyde, consulting engineer on this work, wrote me in August stating that he found the plant at that time working fairly well after eight or nine months' service. There was some odor of hydrogen sulphide which he attributed to the fact that the basins had not been cleaned of scum as often as desirable. The city water contains such a high percentage of sulphates, elimination of the gas is practically impossible if any septic action takes place. The sludge is raised from the sludge pit by means of a centrifugal pump. Notwithstanding the action of the pump upon the sludge, which would tend to liberate the gas therefrom, it seemed to dry readily and to be fairly porous and typical of sludges from deeper Imhoff tanks.

The Author: It is a question whether the condition of the tank at Aberdeen was not in a measure due to

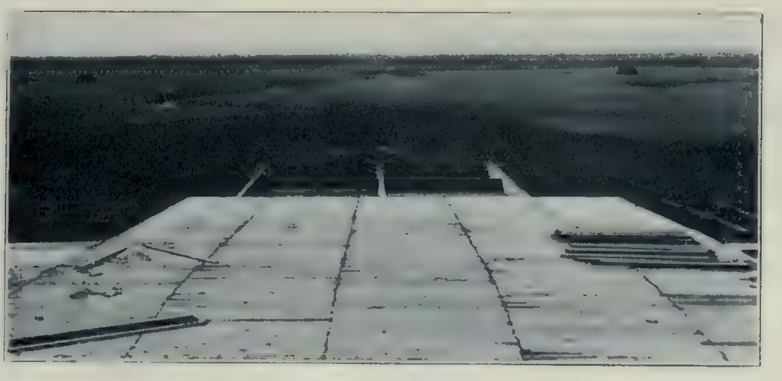


Fig. 10.—Sprinkling filter partly roofed over.

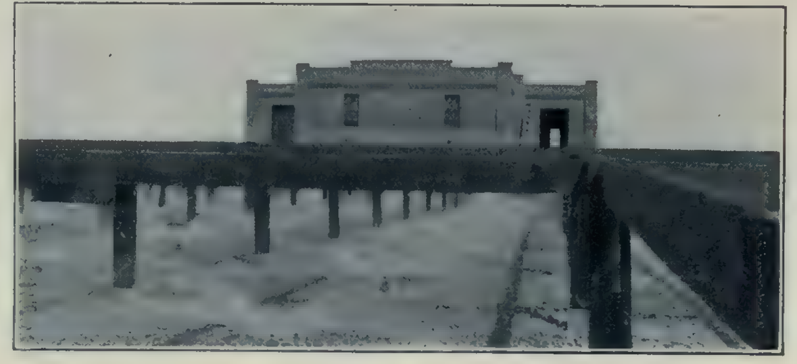


Fig. 11.—Sprinkling filter in operation—Sedimentation tank in background.

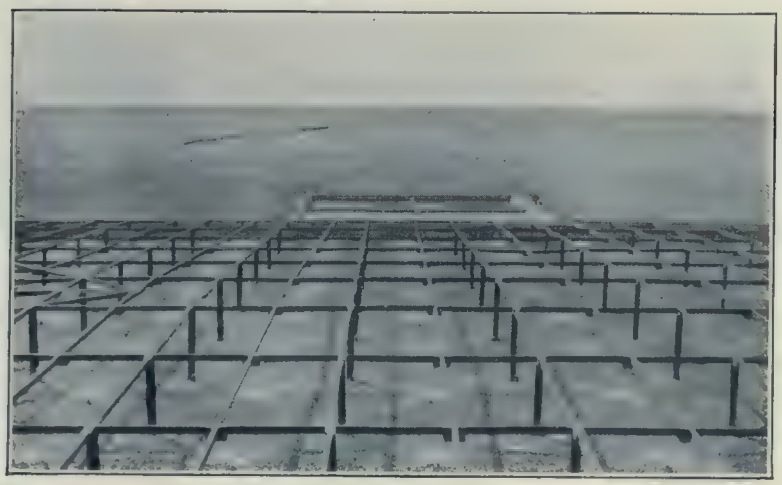


Fig. 12. - Sprinkling filter in operation.—Final settling tank and outlet stream in background.

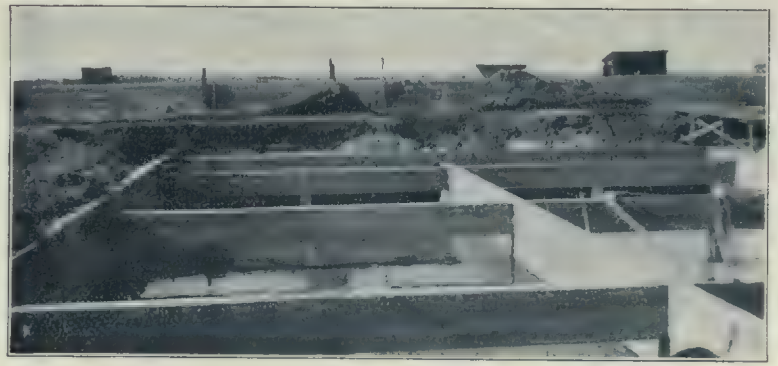


Fig. 13.—General view of final settling tank.

The New Sewage Disposal Plant at Aberdeen, S. D.

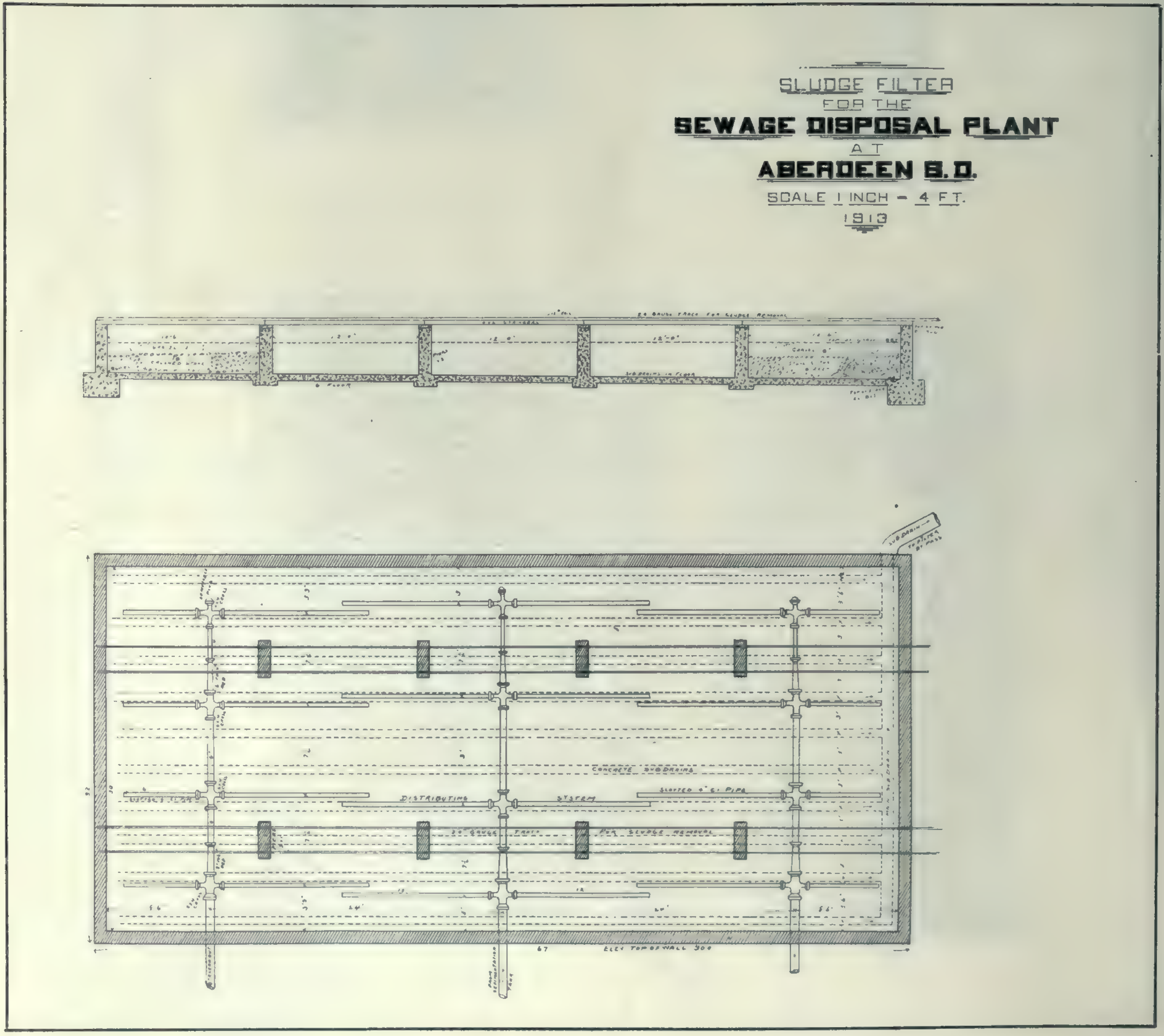
the class of material used in the concrete. The local sand used in this work has a great deal of shale in it. I think that, possibly, was the cause of disintegration.

Mr. DeBerard: The reason ~~for~~ changing the type of tank in the California plant was not because it was not used for city sewage, but because it was used for city sewage, and made more or less of an odor. The water supply of the town was full of sulphates, equivalent to from 150 to 500 pounds per million gallons.

A. T. Maltby: While listening to the reading of this paper there were two things that impressed me. One was that the power provided at the pumping station consists of one 55 h.p. and one 110 h.p. engine, or a total of 165 h.p. The plant, as I understand it, was designed to handle 1½ million gallons per day and the difference in elevation is 25 ft. As the theoretical requirements are only about 6½ h.p. for 26 ft. elevation it would seem that you are providing for a considerable excess of power. My next point is in regard to the depth of the tank; I infer from the reading that it is 17 ft. The general practice in this type of tank seems to be about 30 ft. It is claimed that with this greater depth a better grade of sludge is produced. In other words, a sludge that is better digested and that will dry out to better advantage. There has been considerable discussion on this subject and it would be of interest if the author would keep in touch with the operation and results obtained from this tank. If the shallow type of tank will produce an acceptable character of sludge, it will be a good thing to know, as it would cheapen the cost materially.

The Author: In regard to the power. We have a 26 ft. lift besides the friction from the two-mile force main. And then, too, the larger size engine was put in with a view to some day using that power also for another purpose for the city—running some of the boulevard lights. I think the depth of tanks in Germany is 30 to 40 ft., but there are a number of plants in this country in which the tanks are not so deep. It will be interesting to watch the Aberdeen plant for the coming year or two years, to see what is the effect.

Water for irrigating cannot be judged solely by the taste, states Dr. A. E. Vinson, of the University of Arizona Agricultural Experiment Station, since an injurious amount of black alkali does not reveal itself in this way. For drinking purposes such waters are not harmful. The importance of the quality of irrigating waters is being emphasized by Dr. Vinson.



Investigation of the Discharge of Inflammable Wastes into Sewers

IT is thought that some of the more recent and more violent explosions in sewers were caused by the presence of gasoline vapor. If this belief is well founded it follows that the advent of motor-driven vehicles has created a problem in sewer design and maintenance which may prove difficult and expensive to solve. Sewer systems are generally looked upon by the average person as a quick and easy means of disposing of any or all waste matter which can be carried away by the sewer, without any consideration whatsoever of the effect of such discharge, either upon the structure itself, or upon its maintenance and operation. The transition in the mode of travel from horse-driven vehicles to the motor-driven car and auto-truck renders the transportation, handling and use of large quantities of gasoline necessary and it is inevitable that in the handling of this material some will be spilled or wasted either by accident or design, which will find its way into the sewers. The solution of this problem is now occupying the attention of sewerage engineers. The present article (abstracted by Engineering & Contracting) is from a paper by Mr. N. S. Sprague, Superintendent of the Pittsburgh Department of Public Works, before the recent annual convention of the American Society of Municipal Improvements. It discusses the discharge of inflammable wastes into sewerage systems and the problem of prevention. The scope of the sewer explosion investigation now being conducted in Pittsburgh is also described.

There are many sources which contribute inflammable wastes in a greater or less degree, ranging from the small and irregular discharges from households and private garages, which may amount to considerable in the aggregate, to the large and intermittent discharges from manufacturing and storage plants and other enterprises which use large quantities of gasoline.

In some cities (Pittsburgh included) the laws relating to the storage of gasoline require the tanks to be buried in the ground. These tanks, which are made of riveted steel plates, vary in capacity from about 50 to 15,000 gals. The purpose of placing them underground is to prevent possible ignition of the gas and protect them in case of a nearby fire. It is not the author's intention to discuss the advisability or the objection to placing gasoline storage tanks underground, but simply to point out the possible danger of gasoline escaping from these tanks and entering the sewers. The thickness of the steel plates of which the tanks are made, is generally from 1/8 to 3/16 in. and their only protection from corrosion is the application of ordinary structural paint. The tanks are laid directly upon the ground and then covered with earth. Under such conditions, corrosion is rapid. It is also possible, under favorable conditions, that the tanks may suffer injury due to electrolytic action. In any case, there is no opportunity for inspection or repairs and leaks can only be detected by making a comparison of the quantity of gasoline put into the tank and the quantity removed. This information is in the possession of the owners and in case a leak is disclosed by a comparison of the figures, the owners are not likely to volunteer the information to the public authorities.

The possibility of gasoline escaping from the tanks into the ground and finding its way into the sewers may be remote, but with pervious soil or a nearby catch basin or trap, the opportunity for leakage into the sewers is at least present. In certain locations it is quite possible to set these tanks above ground, where ample opportunity for inspection and repairs would be possible. The waste gasoline from households, private garages and shops is so well distributed throughout the lateral sewer system and the average amount discharged at any one time so small that it is quickly dissipated before the formation of explosive vapors can occur. It is therefore to be supposed that the formation of gasoline vapor and other explosive gases present in sewers originates from establishments which are large users or dealers in inflammable materials.

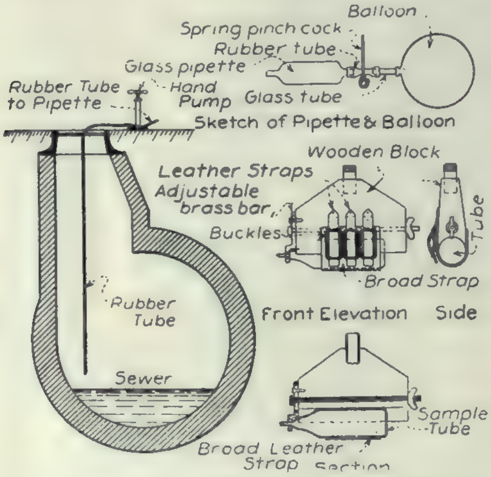
There being in most cases no laws prohibiting the discharge of inflammable wastes into sewers and the danger of such practice not being generally understood, the natural disposition of such wastes is into the sewers. These wastes comprise dirty and used gasoline, benzine, oil, washings from tanks, and refuse from gas plants, paint works, etc. The quantity of these waste products varies according to the magnitude of business and methods employed.

While the discharge of gasoline into the public sewers probably exceeds in quantity any other inflammable waste, yet the discharge of waste products from paint works, oil refineries, gas works, etc., is likely to produce conditions which, under favorable circumstances, may fill the sewer with explosive gas. Ignition of explosive gases, when present in the sewers, may occur in many different ways—for instance: sparks from street railway tracks, hot cinders and sparks from locomotives, stacks, etc., which may enter the manholes through the perforations in the covers, or when same are removed for inspection or repairs; also the dropping of matches or lighted cigars into manholes or catch basins; lights and sparks from tools, while making inspection or repairs within the sewer or at chambers, pumping stations or disposal plants.

The problem of preventing sewer explosions would then seem to be a question of either effectually sealing all openings into sewers or excluding or regulating the discharge of inflammable or explosive wastes.

A number of cities have attempted to solve the problem by procuring legislation prohibiting or regulating the discharge of inflammable waste materials into the sewers. Prior to the general use of motor vehicles there were many industrial and business establishments using inflammable and volatile wastes, such as dry cleaning establishments, paint manufactories, gas works, etc. Notwithstanding the fact, explosions in sewers caused by the ignition of gasoline vapor were uncommon. This fact would seem to indicate that the greatly increased use of gasoline due to the growth of the automobile industry has been responsible for many of the recent sewer explosions.

Accepting this theory as a working basis, we must determine whether or not the gasoline is discharging into the sewers in large quantities by a relatively few people or in small quantities by a great number. In the first case the situation is relatively easy to control, while in the latter, it would be difficult. Moreover, it is necessary and important to determine whether the explosive vapor is generated from the accumulative effect of a great number of small discharges or from the discharge of large doses. Past experience has shown that the ordinary means of providing ventilation in sewerage systems has been generally adequate to prevent the collection of explosive gases. If large doses of inflammable wastes are allowed to enter the sewers, other means of ventilation will have to be provided or the sewers sealed. The installation of mechanical ventilation in sewers throughout the system would remove the gases, but would involve great initial outlay and the cost of maintenance and operation would generally be prohibitive. This scheme would not seem practicable. There is no practical way of providing sufficient ventilation either by mechanical or natural means which would exhaust the air inside the sewer quickly enough to prevent the formation of an explosive compound in case large quantities of gasoline were present in the sewer. With the exclusion of large discharges of gasoline into the sewers, the danger of explosions can be greatly lessened by giving more attention to the improvement of the natural ventilation. This would probably be sufficient to prevent the collection of explosive vapors arising from the normal amount of gasoline discharged into the sewers. To form an explosive mixture a certain amount of air and gas is required. If there is a shortage of gas or an excess of air, no explosion can occur.



Details of apparatus for taking samples of air inside of sewer.

It cannot be ignored that many sewer explosions have resulted from the leakage of natural or artificial gas into the sewers. Evidence has been conclusive in a sufficient number of cases to show unmistakably that this is a fact. The prevention of explosions from this source, however, is well within the jurisdiction of public officials and the remedy is the right construction of sewers and proper laying and location of gas pipes. The remedy in this case consists, therefore, in enforcement of powers that municipalities at present possess.

Modern sewer design provides for the ventilation and inspection of the structure. The discharge of inflammable wastes into sewer systems would not of itself be a serious matter, or objectionable, were it not for the possibilities of igniting the explosive compounds. Ignition of gases in the sewers could be prevented by sealing all openings, but this would prevent inspection and create impossible working conditions inside the sewer when repairs became necessary. Moreover, the sealing of the sewers would not prevent ignition at chambers, pumping stations and disposal plants. In addition to the foregoing, there are other reasons which would make the sealing of the sewers impracticable and inadvisable.

The exclusion of inflammable wastes from a sewer system brings up the question of how it shall be accomplished. The regulation of the Municipal Explosives Commission of the City of New York, adopted January 3, 1912, require the installation of oil separator traps or similar apparatus. The city of Boston requires a special trap which will prevent the discharge of the objectionable wastes into the sewers, and the city of Chicago has somewhat similar regulations to those of New York, governing the matter.

The efficiency of these devices is dependent upon the attention paid to their operation by the individual. Careless operation or neglect might render them of little value and defeat the purpose for which they were installed. Therefore, frequent inspection should be made by the proper public officers. Their general use on all sewer connections where gasoline or other inflammable waste is discharged would seem prohibitive, if found advisable, on account of the cost. The compulsory installation of devices for removing oil will generally meet with opposition by those affected, which has been recently demonstrated by the passage of an ordinance in New York City repealing the ordinance requiring the installation of oil separators. I am informed that this repealing ordinance was vetoed by the Mayor.

Formulation of legislation directed toward the prohibition of the discharge of inflammable wastes into sewers is at present receiving attention in many cities. That the same may be effectual requires the most careful consideration. It is most desirable that the necessity for such regulations be demonstrated and the efficiency of any device thoroughly proved before they are required by ordinance.

The writer has examined the regulations of a number of cities, and has come to the conclusion that it would be best from the standpoint of enforcement, to have all regulations of this nature contained in a single ordinance which would cover all phases of the discharge of wastes of all descriptions into the sewers. Such an ordinance should contain the following:

(a) Prohibition against the discharge of any inflammable gas, volatile inflammable liquid, inflammable liquid, oil or gas, or any calcium carbide or residue therefrom, or any liquid or other material or substance containing inflammable gas or which would evolve an inflammable gas when in contact with water or sewage.

(b) Regulations as to how sewer connections with establishments from which the foregoing wastes emanate may be made. This may or may not require the installation of special traps, separators or similar devices.

(c) Provision for the examination and approval of all intercepting devices and provision for their inspection, maintenance and operation.

(d) Provision with regard to the discharge or placing of obstructing material in any part of the sewer system.

(e) Regulations as to the discharge of steam or hot liquid or gaseous waste into the sewers.

(f) Regulating the location of gas pipes in city streets with reference to the sewer; prohibiting the placing of gas pipes close to or within the masonry of sewers.

(g) Prohibiting connection from manholes, gate boxes, or other apparatus of public service corporations to the sewers, except in an approved manner and when properly trapped.

Legislation alone will not secure or prevent the discharge of these objectionable wastes into sewer systems, but by informing the people of the damage resulting from this practice, the offence will be greatly lessened.

It would appear desirable, in the interest of public safety, where oil separators or similar devices are installed, for the municipality to undertake the final disposition of the residue rather than entrust it to the individual. The importance of the problem of regulating the discharge of inflammable waste, etc., and the necessity for its strict and effectual regulation has been amply and forcefully demonstrated by recent violent and destructive explosions.

As recently as September 22, 1914, another serious explosion occurred in the sewer on East 42nd Street, between Third Avenue and East River, New York, making the third explosion in the same sewer within a year. Reports state that the physical damage to the sewer, buildings and street, was not extensive. This is accounted for by the fact that the sewer was a brick-lined tunnel in rock about 40 ft. below the street surface. Under less favorable conditions of location and design this result would have been far more serious.

The most disastrous and expensive sewer explosion up to the present time, although entailing no loss of life, occurred at Pittsburgh on November 25, 1913. This explosion to date has cost the city about $300,000, which may be increased by possible damage suits.

This problem is not confined to the prevention of explosions in the sewers themselves, but may extend to all kinds of sewerage works as shown by the explosion in the screen chamber at East Boston, which occurred June 1st of this year. In this explosion, which was caused by the presence of gasoline vapor, six lives were lost and three men severely injured.

Without mention of other recent sewer explosions, it is evident from experience covering many cities, that an immediate, effectual and permanent remedy must be found to control the situation. With three explosions in the 42nd Street sewer in New York and two in the 33rd Street sewer in Pittsburgh, all within less than a year of each other, there can be no question but what the conditions inside of all large sewers draining garages, etc., are such as to produce explosions whenever ignition occurs. The safety of the public and the welfare of the community are therefore now dependent more upon good fortune than the certainty of scientific control, hence the public is always exposed to the hidden danger which only requires a chance spark to cause havoc and disaster.

The present situation can be likened to the man sitting on a keg of powder.

Sewer Explosion Investigation at Pittsburgh

The city of Pittsburgh, immediately after the second explosion, set about to make an investigation and study with a view of preventing a repetition of such disasters. This investigation is being conducted jointly by the city and the local office of the U. S. Bureau of Mines, who have rendered valuable assistance and advice.

The purpose of this investigation, which is still in progress, follows: (1) To locate all possible sources from which gasoline or other explosive wastes might enter the sewers. (2) To determine by a series of examinations and tests the location of the sources where the waste was discharged. (3) The determination of the presence, extent and quantity of vapor within the sewers. (4) Experiments to determine the effect and behaviour of gasoline dumped into the sewer in different quantities and at different intervals.

The 33rd Street drainage basin was selected for study because of the number of garages within the basin and the fact that two explosions have already occurred, indicating the discharge of large quantities of explosive waste into the sewer. The 33rd Street drainage basin has an area of 1,642 acres, a population of 53,785, and a total of 417 structures where inflammable and explosive materials are handled. These structures are classified as follows: 295 small garages, not more than two cars, includes private and small business garages; 67 large garages, not less than three cars, includes public garages, repair shops, large business garages, etc.; 12 gasoline storage establishments; 1 dry cleaning establishment; 2 paint shops; 39 business or manufacturing places where inflammable oil or gases are manufactured, used, sold, handled or washed; includes gasoline supply establishments, large automobile establishments where gasoline is stored, sold and used in large quantities.

A map was prepared showing the outline of the basin, the sewer system within and the location of all garages, dry cleaning establishments and other places where inflammable or explosive wastes are likely to be discharged into the sewers. The map will be used in connection with studies to locate the point or points where the discharge of inflammable wastes occur.

Letters of inquiry were sent to all the principal cities in the country with a view of obtaining data and information relative to sewer explosions and what laws or ordinances were in force regulating or controlling the discharge of inflammable or explosive wastes into the sewerage systems. The answers received in reply to those inquiries were compiled and have been printed in pamphlet form and copies furnished to each city supplying information.

Apparatus was designed for securing samples of air within the sewer and for making field tests of same. The apparatus used is shown in the accompanying cut.

The results so far secured in the investigation indicate the presence of gasoline vapor in the sewers of both the 33rd Street and Negley Run systems. This latter system drains an area of about 2,500 acres with a population of about 50,000 and there are considerably less sources from which inflammable wastes are discharged than in the 33rd Street system. Analyses of a series of samples taken on the same day at various points in these systems have shown that gasoline vapor in small amounts is present throughout the sewer system. The gasoline vapor ranges from 0.012 to 0.065 per cent. of the volume of sewer air in the sample. While these percentages of gasoline vapor are considerably below the danger mark, which may be taken as 2 per cent., it goes to show that the natural ventilation of these sewer systems is not sufficient to remove the effects of the ordinary or normal discharge of gasoline.

The Negley Run system drains through duplicate outlet sewers for a distance of over a mile, during which distance there are no connections known which could by any possibility discharge gasoline. Above this point, there are a number of large branch sewers of considerable length so that taking these larger sewers of the system together with the many miles of laterals, with the opportunity for ventilation provided, it must follow that natural ventilation would not suffice to remove the effects of the discharge of gasoline in large doses.

It is expected that these experiments will require considerable time before definite conclusions can be reached and preventive measures, based upon them, can be formulated, but it is hoped that some plan or action can be devised which, without imposing hardship or undue expense upon the people, will secure to them freedom from the peril and danger to which they are now constantly exposed.

Road Construction Plant and the Contractor

UPON undertaking road construction it is required to be determined what type of construction plant is best suited to the work in hand, how much plant is required to complete the work with the greatest economy and profit, and what additional plant is required to expedite construction so that time limitations will not be exceeded.

Every construction project has certain fixed limitations within which the contractor must keep in planning work to be accomplished. These limits may be due to varied and uncontrollable causes, such as the type and number of laborers available, the location of the project with reference to bases of supplies, the length of profitable working season, topographic conditions with reference to ease of hauling and as affecting the installation and use of plant, climatic conditions during the working season—a most important factor—and facilities for quickly and profitably disposing of or storing plant after the completion of the work. Moreover, on contract work specifications invariably define other limits, such as the time of completion, the type and quality of material to be used, involving possible delay in securing materials at the proper time and consequent disorganization and loss to the contractor, and the possibility of important changes in the plan and extent of the work while in progress.

The foregoing are the broad general conditions confronting the contractor upon undertaking road construction work. In attacking this equipment problem the three important questions to answer are: What plant is best suited to the work, how shall it be acquired, and what will be its value after the completion of the work? In answering these questions sound experience is undoubtedly of greatest value in the proper correlation and nice weighing of the conditions affecting the proposed work.

There are, however, a few general rules of thumb in vogue among contractors that are worthy of mention. Plant is a substitute for labor, and its use is economical only when it will yield a good return on the investment over and above the labor cost without the use of plant. The economic ratio between plant and labor is, in a measure, a fixed quantity for each construction project. Whether or not any plant at all is needed and what is the least amount with which the work may be accomplished are fundamental questions. Finally, second-hand plant is to be avoided if the contractor expects to continue in the same line of contracting; if he expects to undertake a different type of work on the next project it may be a profitable investment.

Many contractors do not figure on plant expense when bidding on work. The first job undertaken is frequently figured with no profit other than the plant purchased. On succeeding jobs plant cost is not included, unless new plant is required. In short, the job pays for the plant. In figuring on the disposal of the plant at the conclusion of the work, as a rule, heavy machinery if sold will not bring to exceed 25 per cent. of the first cost. Light machinery and small tools are usually worn out on the job and at its termination must be disposed of as scrap. Second-hand machinery ordinarily sells at about 50 per cent. of its first cost after overhauling by machinery dealers. The salvage value of second-hand machinery but slightly used is larger than that of slightly used new machinery. In other words, the ratio of the value of third-hand to second-hand machinery is greater than second-hand to first-hand machinery.

A Song of Six Per Cent.

An inside, professional view of the architect's scale of remuneration is contained in the following humourous verses, recited at a recent meeting of the Cleveland Chapter of the American Institute of Architects:

"Sing a song of six per cent.
Pockets full of dough,
That's what the client thinks
Because he doesn't know.
Poor darned architect
Knows he's just a slob;
Six per cent. is not so much
Unless you've got a job.

Sing a song of six per cent.
Arc'tec full of rye;
Million-dollar c'mmissions
Float before his eye;
When the night is over,
How his head does ache!
A yiddish flat at two per cent.
Is what he'll gladly take."

Construction plant is the great problem of the road contractor. The cost of plant used frequently exceeds 33 per cent. of the total cost of the work accomplished and seldom falls below 20 per cent. Unless plant is keenly judged, shrewdly acquired and kept constantly at work the profits of the road contractor may be continually feeding the mill in the merry-go-round of machinery purchasing.—Engineering and Contracting.

The policy of the British Columbia Government reflects the greatest optimism and confidence. Public works are proceeding, new construction is being opened up in various sections by the railways, and every effort is being made generally to maintain the stability of the business situation.

Good roads prevent disease, according to the State Board of Health of Kansas. The removal of weeds and trash, which prevent the evaporation of moisture and promote the retention of ground water, deprives mosquitoes, flies and other disease carriers of their breeding spots. Good roads also prevent disease by providing good drainage.

The unit method of reinforced concrete construction has an advantage over monolithic construction in the speed with which buildings can be erected. This is often a very valuable consideration where replacements are being made, or where the work is needed in a great rush.

Personal Mention

Mr. R. L. Werry has resigned the Secretaryship of the Montreal Builders' Exchange.

Mr. L. A. St. Marie is the new Town Engineer of Longueuil, P.Q., succeeding Mr. Prefontaine.

Mr. Chas. Johnston has been appointed Assistant Engineer to Mr. H. S. Van Scoyoc, Chief Engineer of the new highway between Toronto and Hamilton.

Mr. Arthur Surveyer read a paper "Making our Water Powers Valuable" at a recent meeting of the Electrical Section of the Canadian Society of Civil Engineers in Montreal.

Mr. W. E. Bradshaw lectured recently before the Engineering Society of the University of New Brunswick on the design and construction of the new bridge over the Reversible Falls at St. John.

Mr. F. S. Mallory, architect, has taken over the offices at 65 Adelaide Street East, Toronto, of the late Mr. F. H. Herbert, with whom he had been associated in practice for a number of years.

Mr. Wm. Pearce gave an interesting address at a recent meeting of the Calgary Branch of the Canadian Society of Civil Engineers. The subject of Mr. Pearce's observations was "Irrigation in Egypt."

Mr. J. M. Wilson has been appointed to succeed Mr. J. G. Sing as resident engineer in Toronto for the Department of Public Works. Mr. Wilson was formerly assistant resident engineer in that Department.

Mr. Geo. Janin, City Engineer of Montreal, who recently organized a corps of engineers for active service, has obtained a commission and will go into training with the men. Mr. Janin is 61 years old, but he is eager to go to the front.

Mr. James L. Brusse, a young civil engineer of Vancouver, B.C., was killed recently on a huntng trip in British Columbia. He was 28 years old, a native of Denver, Colo., and a graduate in civil engineering of the University of Denver.

Mr. Kenichi Nakamaura, a civil engineer on the staff of the Imperial Government Railways of Japan, and Mr. H. Sugi, of the engineering department of the railways, are in Canada for the purpose of studying the railways of the Dominion.

Mr. Geo. J. Bury has been appointed Vice-President of the C. P. R. in succession to Mr. David McNicoll, whose resignation owing to ill-health was announced recently. Mr. Bury is a native of Montreal and joined the C. P. R. as a clerk in 1883.

Mr. George W. Hunt, formerly President and General Manager of the Canadian Asphalt Company, Limited, has been appointed Sales Manager for Mr. John Baker, Jr., dealer in asphalt, bituminous products and road oils, 10 South La Salle Street, Chicago.

Mr. James Geddes, assistant to the general manager of the Louisville & Nashville R. R., of Nashville, Tenn., who died recently, was born, 1828, at Portsoy, Scotland. From 1846 to 1850 he was with the civil engineering department of the Great Western Railway, England. On coming to America he was for eight years, 1851 to 1858, a location and construction engineer of the Louisville& Nashville R. R. He then entered the operating department and for many years was superintendent of the Nashville division. Since 1901 he has been assistant to the general manager.

The Eleventh Annual Convention of the Sand-Lime Brick Association is to be held at the Algonquin Hotel, Dayton, Ohio, December 8-9 next. The President of the association is Mr. S. O. Goho, Harrisburg, Pa., and the Secretary is Mr. W. E. Plummer, Jr., Buffalo, N.Y. It is of interest to note that a paper, entitled, "Sand-Lime Brick in Europe," is to be read on the second day of the meeting by Mr. Harold D. Robertson, of Toronto.

Regina Engineering Society

At the annual meeting of the above Society, held recently, Mr. L. A. Thornton (Works Commissioner) was elected President and Mr. J. M. Mackay (Superintendent of Waterworks) Secretary for the year 1914-15.

About thirty members took part in a visit to Moose Jaw where the City Engineer, Mr. Geo. D. Mackie, had made elaborate arrangements, including a special street car and a fleet of automobiles, for showing the party around the various works of engineering interest in the city. Among those visited were the Power station (where a demonstration of the recently-installed high pressure water system was given); the sewage disposal plants, the new Dominion Government internal storage elevator, and the Robin Hood flour mills.

Mr. L. A. Thornton, the newly-elected President Regina Engineering Society.

The Society's annual dinner was held in the King's Hotel, Regina, early last month. The guests included His Honour Lieut-Governor Brown, Chief Justice Haultain, Mr. Wm. M. Martin, M.P.; Mr. J. F. Bole, M.L.A.; Mr. Robt. Martin, Mayor of Regina; and Mr. Jas. Pascoe, Mayor of Moose Jaw.

A meeting of the Society was held in Regina College on Thursday, December 3rd, when the President delivered his inaugural address.

The annual general meeting of the Province of Quebec Association of Architects will be held in the Association Rooms, 5 Beaver Hall Square, Montreal, on January 16th, 1915, at 9 a.m. The examination for admission to the study of architecture or registration in the Province will be held on January 25th, 1915, and on the following days, in the rooms of the P. Q. A. A., at nine o'clock each day.

Rapid Earthwork Calculation. By C. E. Housden. Longmans, Green & Company, New York City. 31 pages, with diagrams and tables. Price 50c. An interesting little work embodying improvements in earthwork calculation suggested by a careful reconsideration of the author's "Practical Earthwork Tables." These tables, as well as their application, are considerably simplified yet left sufficiently full to allow of correct results being arrived at under all the conditions likely to be met with in actual practice.

Mainly Constructional

East and West—From Coast to Coast

EASTERN CANADA

At Levis, Que., the Intercolonial Railway has decided to build a new station to replace the structure recently burned down.

The ratepayers of Guelph, Ont., will be asked next January to vote on a proposal to spend $125,000 for a new Collegiate Institute.

The Toronto city council has decided not to submit a by-law next January in connection with the proposal to raise an additional $167,000 for the Gerrard Street Bridge project.

St. Catharines city council have in contemplation a scheme for strengthening the bridge across the Welland Canal in order to provide for heavy through cars on radial lines.

At Hamilton, operations have commenced on sewer work estimated to cost $130,000. Tenders for new pump-house and pumps will not be called until next summer. The City Engineer is Mr. A. F. Macallum.

The government is considering an application for $270,000 from the County Council of Halton, Ont. The money is to be utilized along with a similar sum already raised by the county for building 160 miles of good roads.

The city of Sarnia, Ont., has raised $112,814 to be expended on the purchase of the Port Huron Thresher Works, which plant is on the site required by the Grand Trunk Railway for the location of their car shops at S. Port Huron.

At Felicien, Que., work is progressing on the construction of a new church for the Parish of St. Felicien, 212 x 75 feet, stone construction, the estimated cost of which is $125,000. Mr. Joseph Bouellet is the architect, the general contractor being Mr. E. Trembley.

Mr. J. S. Ferguson, of the Northern Development branch of the Ontario Service, died suddenly at North Bay, Ont., recently. He was 50 years of age and for the past three years had been associated with Mr. J. S. Whitson on road construction in Northern Ontario.

At Toronto, Ont., a by-law will be submitted on January 1 to authorize the construction of a civic car line in North Toronto, at an estimated cost of $455,000. The project is to include the running of lines south from Earlscourt, Hillcrest and Wychwood districts.

According to an estimate supplied by the city engineer, the cost of building a bridge to connect South London with the south end of Richmond street would be approximately $37,000, the steel work alone costing $25,500. The bridge would have a length of 650 ft. with a span of 190 ft.

At St. Catharines, Ont., a plan has been proposed by the City Water Commission by which Port Dalhousie will receive a water supply from the city system, the village to lay a main to the city limits. They will also be required to maintain it and contribute a rate to be agreed upon later.

The Harbor Commissioners of Hamilton, Ont., are considering a scheme for the widening of Desjardins Canal to 300 feet and dredging it to a depth of 25 feet, with turning basins. It is proposed to reclaim the remaining marsh area and to have regulation roadways, 66 feet wide, along either side of the banks.

It is pleasing to record that the foundry of Messrs. Thompson & Sutherland, N. Sydney, N.S., which has been out of commission since its partial destruction by fire last September, has been reopened. All the old staff has been re-employed and it is expected that sufficient work will be forthcoming to keep them engaged throughout the winter.

Good progress is being made on the steel work of the new building which the Excelsior Life Association is erecting in Toronto at a cost of $500,000. The building is to be eleven storeys high, of steel, terra cotta and brick construction. The architect is Mr. E. J. Lennox, and the general contractors are Messrs. Peter Lyall Construction Company.

At Ford City, Ont., the new factory for the Ford Motor Company of Canada is well advanced on the way to completion. The building is six storeys, 200 x 195 feet, steel and reinforced concrete construction, and will cost, when completed, about $300,000. Messrs. John Graham & Company, Windsor, are the architects and Messrs. Wells & Gray, Windsor, the general contractors.

The Canada Electric Company, Montreal, have secured a contract for electrically equipping the new Customs house, Ottawa, which is being constructed by Peter Lyall & Sons Construction Company, Limited. Six transformers will step down the current for lighting and power purposes. The elevators, ventilating, pumping, and heating systems will be electrically operated, direct connected motors being installed.

Expenditures totalling $6,000,000 have been made on the Welland canal work this season, and the four contracts under way are one-quarter completed, according to a report from Ottawa. Four sections are yet to be contracted for, but they are so located that it is not advisable that they be let until the work on the existing contracts is further advanced. It is estimated that the canal work will be completed in two years.

The firm of Kerry & Chase, Consulting Engineers, Toronto, have been appointed to consider and advise regarding the feasibility of constructing a mountain-top reservoir in connection with the projected scheme of Hydro and City Water-Works amalgamation at Hamilton, Ont. A large number of applications for the position were received at fees ranging from $10,000 to $700. The engineers will proceed with the work as soon as the appointment has been ratified by the Board of Control.

The new plant at Longueuil, Que., for the firm of Armstrong & Whitworth, of Canada, Limited, is almost completed and it is expected that all branches of the building will be in operation during December. From the outset some 200 men will be employed and this staff will be augmented as the market improves. It is the intention of the company to manufacture a high-grade of crucible steel which up to the present has not been made in Canada. The announcement has also been made that a projectile shop will possibly be built next year. Armstrong & Whitworth plants in England are at present working to capacity, the firm having in their employ over 50,000 workmen. The bulk of the labor is devoted to the manufacture of British Government requirements.

WESTERN CANADA

The new school building erected at the corner of Helen and Fleet Streets, Winnipeg, at a cost of $150,000 is nearing completion. The building is of stone, brick, and reinforced concrete construction.

Plans are in preparation by Mr. Geo. Schioler, Bridge Engineer, for the construction of a new bridge over the Lee River near Lac du Bonnet, Man., on the city's Power Plant Tramway, at an estimated cost of $20,000.

Foundations are in for the new court-house which the Saskatchewan Provincial Government is building at Swift Current at a cost of over $100,000. The building is to be two storeys high, of stone, brick and reinforced concrete construction. The general contractors are Messrs. R. J. Lecky Company, Limited, Regina.

The Dominion Government is expending the sum of $4,500,000 on public works in the vicinity of Victoria, B.C. This outlay does not include the Esquimalt Dry Dock, upon which construction will be started in the near future.

Finishing touches are being put on the new "Balmoral" school which has been erected at Crescent Heights, Calgary, at a cost of $185,000. The building is three storeys high, of limestone and fireproof construction. The general contractor is Jas. McPhail, Calgary.

At Victoria, B.C., the Hudson's Bay building now under construction by the British Columbia Construction Company is to be completed four storeys as originally planned. For some time the board of directors have been considering the advisability of completing only three storeys.

Exterior work is reported to have progressed rapidly on the new armoury which the Dominion Government is building at Edmonton at a cost of $286,000. The building is to be two storeys high, 175 x 275 ft. in dimensions, of brick and stone construction. The general contractors are Messrs. Peter Lyall & Sons.

At Burrard Inlet, B.C., the firm of Barnet, McQueen & Company, of Fort William and Minneapolis, have put in the lowest tender for the construction of a Pacific Terminal Elevator to be built here by the government at an estimated cost of $1,000,000. The storage capacity of the elevator will be one and a quarter million bushels.

The new school building which the Winnipeg Public School Board is erecting on Manitoba Avenue at a cost of $150,000, is practically completed. The building is three storeys high, of brick and reinforced concrete construction. The architect is Mr. J. B. Mitchell, of Winnipeg, and the general contractors are Messrs. Claydon Bros., of Winnipeg.

At Winnipeg, Man., there is a possibility of a site for building purposes being selected by the Globe Pump Company of Green Bay, Wis., one of the largest manufacturers of deep well pumps on the Continent. The company are considering a scheme for locating a branch plant in Canada and with that object the manager, Mr. R. I. Byington, visited Winnipeg recently.

Plans are being prepared for the "Clark Drive" trunk sewer, which is part of the Vancouver and District joint sewerage scheme. The cost of this section of the work is estimated at $325,000. Constructional operations are to be put in hand as soon as the plans are completed. No decision has yet been reached as to whether to undertake the work by contract or by day labor.

The ratepayers of West Vancouver, B.C., voted last Saturday on a by-law to raise $150,000 for the installation of a water-works system. At the time of going to press the Contract Record had not been notified of the result. The plans of the system were prepared by Mr. H. McPherson. The proposed source of supply is at the head of Sister's Creek. It is hoped to start work in January.

The City Council of New Westminster, B. C., have authorized the Water Committee to proceed with the construction of a new reservoir to increase the city's available water supply. The work is to be done by day labor under the superintendence of the board of works. The reservoir will have a capacity of 5,000,000 gallons. Its construction will involve the excavation of 28,000 cubic yards of earth.

The Hudson Bay Railway is practically completed from Le Pas, Man., to Thecket Portage, a distance of 180 miles, according to official reports to the railway department. On the second section to Split Lake, steel is now being laid, while on the third section, between Split Lake and Port Nelson, clearing and grading is well advanced. The work will go on this winter and completion is looked for early in 1916.

Announcement was made by Mr. J. W. Stewart, President of the Pacific Great Eastern Railway, on his return from a trip over the route of the new line from Squamish to Fort George, that judging by the present rapid rate of progress, grading would probably be completed on the entire road by the end of the year. Track laying is proceeding beyond Pembleton and is nearing the summit at the head of Anderson Lake, about 85 miles from the Ocean Terminal. There are about 6,000 men employed on grading operations, notwithstanding that the completion of several sections of grading has resulted in reductions. As is generally known, the extension is planned to connect with the Edmonton and Dunvegan Railway on which construction work is understood to be well advanced.

The MacArthur Concrete Pile & Foundation Company have sold to the Oriental Compressol Company of Tokio, Japan, the patent rights to drive the pedestal pile in Japan. The MacArthur Concrete Pile & Foundation Company have appointed Douglas-Milligan Company as their Sales Agents for Eastern Canada, with main office in the New Birks Building, Montreal, and branch office at 95 King street east, Toronto.

Bulletin B.10 of the Herbert Morris Crane & Hoist Company, Limited, Toronto, contains some illuminating details as to the manufacture and possibilities of Morris chain-blocks. One of the illustrations shows the largest standard chain-block in the world—made for a load of sixty tons. An idea of its proportions is conveyed by a chain block of one-quarter ton capacity which has been photographed alongside the larger product. All Morris chain blocks are subjected to a fifty per cent. overload test. In this case it is ninety tons.

The Glengarry and Stormont Railway, connecting Cornwall with St. Polycarpe Junction, on the Canadian Pacific Railway, is expected to be in operation at the beginning of 1915. The total cost of the line is given as $875,000. Nearly all the construction material was purchased in Canada, although two steam shovels costing about $10,000, a steel water tank costing $4,000, and $3,000 worth of dumping wagons were bought from concerns in the United States. The rolling stock, to consist of about 4 engines, 30 passenger coaches, 60 freight cars, and 20 construction cars, is either to be purchased or to be supplied from the equipment of the Canadian Pacific Railway. Quotations, c.i.f. Montreal, should be sent to C. L. Harvey, president of the Glengarry Construction Company, 400 St. James Street E., Montreal.

The MacArthur Concrete Pile & Foundation Company have appointed The Douglas Milligan Company their Sales Agents for Eastern Canada, with main office in the New Birks Building, Montreal, and branch office at 95 King Street East, Toronto. The MacArthur Concrete Pile & Foundation Company are equipped to construct foundations for all sorts of structures where unfavorable soil conditions are encountered. They have already done a large amount of this work both in Canada and the United States. Some of the work executed by this company in Canada includes foundations for two large buildings at the plant of the Oliver Chilled Plow Works, Hamilton, Ont.; power house at Mt. Dennis (Toronto) for The Canadian Kodak Company; all of the large ship-building plant of the Canadian Vickers, Limited, Montreal; Canadian Postal Station "C," Montreal; Immigration Sheds for Canadian Government at Quebec; power house for Dorchester Electric Company, Quebec; and piles for an international bridge across the St. Johns River at St. Leonards, N.B.

Contracts Department

News of Special Interest to Contractors, Engineers, Manufacturers and Dealers in Building Supplies

Waterworks, Sewerage and Roadways

Burlington, Ont. (Hamilton)
All material except meters and ¾-in. lead pipe has been purchased in connection with waterworks construction for the village council, at an estimated cost of $12,000. Mr. James S. Allen is village clerk.

Hamilton, Ont.
Bids addressed to Mr. R. F. Miller, 501 Bank of Hamilton Building, will be received for digging and laying 15 miles of gas mains along city streets for the Natural Gas Company.

Hull, Que.
The ratepayers will vote on a by-law next January to authorize the enlarging and extension of watermains through the Municipality. Estimated cost $100,000. Mr. J. A. Laforest, Town Hall, is the town engineer.

Maisonneuve, Que. (Mont.)
Plans are drawn and together with specification have been submitted to city council for improvements and paving to Pius IX. Boulevard, 100 ft. wide with 12 ft. sidewalk on each side. Approximate length 4 miles. Mr. M. Dufresne, Ontario Street, is the architect and engineer.

North Vancouver, B.C.
A by-law has been passed authorizing the expenditure of $75,000 by the Municipal Council on paving work. Mr. A. M. West is city engineer. Mr. J. Cowlins, city clerk.

Nanaimo, B.C.
Construction will be started shortly on asphaltic concrete pavement on Haliburton Street, from Grace Street to city limits, at an estimated cost of $37,764. The city engineer is Mr. Owen and city clerk Mr. S. Gough.

Ottawa, Ont.
Work is proceeding on the construction of trunk sewer on Nicholas Street at an estimated cost of $3,500 by the City Council. Work is being done by day labor. Mr. R. L. Haycock is the engineer.

Montreal, Ottawa and Georgian Bay Canal Company will apply to Parliament next Session for an extension of time for the construction of the Georgian Bay Canal. This is a private company which is said to own a charter to build the proposed waterway.

Tenders will be called for balance of work, which includes asphalt pavement between Elgin and Bank Streets, estimated cost $16,600. Mr. F. C. Askwith is the city engineer.

The city council will take tenders on the balance of asphalt pavement work between 5th Avenue and Centre Street estimated to cost $8,500.

Work on grading of Scott Street, between Merton and Garland, will be done by day labor.

In connection with $62,000 asphalt and stone block pavement on Bank Street, between Echo Drive and Riverdale, the surface drainage of which has been started by day labor, tenders will be called shortly for balance of work. Mr. F. C. Askwith is the city engineer.

Peterborough, Ont.
The City Council has instructed Mr. Parsons, City Engineer, to prepare plans and estimate for surface drainage in various parts of the city.

Port Coquitlam, B.C.
Debentures have been sold and the first installment of 8,000 will be used immediately in connection with the carrying out of road improvements here at an estimated expenditure of $100,000.

Saskatoon, Sask.
Plans have been filed for the construction of a 24-in. force watermain under the South Saskatchewan River, from 11th to 6th Streets. Mr. Junius Johnson is city engineer. Mr. A. Leslie is city clerk.

Toronto, Ont.
The recommendation of Mr. Harris, Commissioner of Works, has been approved by the Works Committee, for the opening of a roadway through Mount Pleasant Cemetery. Two small bridges, 112 ft. foot bridges and 180 ft. trestle, will be constructed. The scheme will cost approximately $275,000.

The following pavement work has been recommended for this city:—Asphalt on Rowland, Fisken, Vernon, Jennings, Glenwood & Kennedy; estimated cost $21,779. Brick block, Hain, Evelyn, Glenwood, Indian Road Crescent, Hillsview; estimated cost $22,202. Treated wood block on Front Street West, at an estimated outlay of $17,120. Mr. R. C. Harris is Commissioner of Works.

Tenders close on December 22nd with Board of Control for sewers on Bastedo, Concord, Delaware, Earlham, Merrill, Ridge, Roseheath, Rose Park Drive, Sawden, Sprott, Stacey, Stanton & Keswick. Plans are at office of Works Department, City Hall.

The construction of concrete curbings on six streets at an estimated cost of $4,164 has been recommended by Works Commissioner, Mr. R. C. Harris.

The Commissioner has recommended a 66 ft. roadway through Prospect Cemetery at an estimated cost of $30,000.

Winnipeg, Man.
Tenders will be received by Board of Control until December 11th for laying sewers at an approximate cost of $11,000 Two-thirds of labor is to be obtained through Civic Equipment Bureau in two shifts. Plans and specification are at office of engineer, Mr. W. P. Brereton, 223 James Street.

CONTRACTS AWARDED

Brooke Twp., Ont.
The general contract to lay drains here for the township council has been awarded to Woolman Construction Company, Sandusky, Mich., at $6,812. Work is to start at the beginning of April. A number of culverts not included in the general contracts will be constructed. Mr. W. J. Bourne, Lot 13, Con. 6, Brooke Twp., Alvinston, Ont., is township commissioner.

Railroads, Bridges and Wharves

Chatham, Ont.
No contract work will be done this year on bridges under construction for the City Council and Dover Twp. Steel work on nine bridges has been completed and steel work is under way on other two. Mr. J. E. Doyle, Cross Street, is the engineer.

Cranbrook, B.C.
The Canadian Pacific Railway Company have been authorized to construct a spur line into the premises of Yahk Lumber Company, Limited, Cranbrook.

Hamilton, Ont.
A High-Level Bridge at Carroll's Point, estimated to cost $327,000, will probably be erected under the supervision of Toronto-Hamilton Highways Commission. Bridge plans have been prepared by the Hamilton Bridge Company. Concrete plans are to be submitted by the Canada Cement Company. Mr. George H. Gooderham, Toronto, is Chairman, Highways Commission.

Repair work by day labor will be carried out on revetment wall for Harbor Commissioners, estimated to cost $20,000. Work will be concrete construction. Mr. H. E. Waterman, 67 James Street S., is secretary.

Leamington, Ont.
Tenders will be received until Thursday evening, December 10th, for drainage work on 6,500 feet of open drain, 3,371 feet of 48-in. and 1,456 feet of 36-in. reinforced concrete tile or segment block; 5,891 feet of 30-in. and 20-in. glazed sewer tile; also construction of concrete highway bridge. Along covered section which lies mostly through the town a connection will be left for each block. Plans and specification are at office of engineer, Mr. John A. Baird. Estimated cost of work, $25,000. Mr. R. M. Selkirk is town clerk.

Province of Alberta
The Canadian Northern Railway will construct a spur line for Rosedeer Coal Company, Limited, Rosedeer; a spur to serve the Star Coal Mines, Limited, and a spur to serve Alberta Block Coal Company, Limited.

Province of Manitoba
The Canadian Pacific Railway Company are constructing a railway spur for

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Alphabetical Index of Advertisers
Page 18

Vol. 28 **December 16, 1914** **No. 50**

Principal Contents

Page
The Toronto Technical School ... 1509-10
Dominion Charters Upheld by Privy Council ... 1510
The Part of the Engineer in the Community ... 1510
Design and Construction of the Central Technical School, Toronto ... 1511-15
(Staff Article)
Recent Practice in Bituminous Construction and Maintenance ... 1516-19
By Wm. D. Uhler
The Disposal of Trades Waste ... 1519-21
By J. W. Sheridan
Methods Which Make for Profit or Loss in Estimating ... 1522-24
Developments in Pumping Machinery ... 1524-25
By Wm. Perry
Protection of Unfinished Concrete ... 1525
The Possibilities of Brick in an Educational Exhibit. 1526-29
A Discussion of Building-Factor Costs ... 1529-30
By Harold L. Green
The Contractor and Engineering Problems in the Home ... 1531-33
By Chas. F. Smith
New Street Lighting System at Outremont ... 1533
Convention News ... 1533
Personal Mention ... 1534
Constructional News ... 1534-35

The Toronto Technical School

Of the many descriptive building articles which have been published in the Contract Record during 1914, none has been of more general interest than that relating to the Central Technical School, Toronto, published in this issue. The article is devoted primarily to features of design and construction, and so, naturally, it is of particular interest to the constructor, but there are outstanding facts which concern the layman and all identified with municipal and other governing bodies.

The general aspect of this undertaking is not discussed in the article and so it is fitting to make passing mention of it editorially.

In this magnificent building, erected at a cost of some $2,000,000, Toronto has a standing monument to progressiveness and material proof of an understanding of present-day requirements. The example is one which may well be followed, particularly in Western Canada, where the facilities for technical education are so lamentably few. At this very time, when business conditions are quiet, funds hard to obtain, and building work slackening, an impetus to the activities of many a community throughout the country might be given by the technical school movement. The erection of a building on the Toronto scale would not have to be considered in many cases and in some instances the expenditure might even be reduced by a couple of ciphers. Funds may be scarce, but money is always obtainable for sound legitimate projects that have substantial backing, and contracts for such buildings could not be awarded at a better time than the present. The employment which these undertakings would provide for the working classes would be a Godsend to the country and the advantages accruing would be far more general than in the case of such work as road construction, where the skilled mechanic is either out of it or has to join the unskilled ranks to earn a living. The monument which Toronto is raising is a permanent appeal to the country.

Municipal, county and provincial bodies are united at the present time in opposing unnecessary expenditure—and rightly so, but it is not sufficient to be united in works of **omission** at such a time as this. The country's present need is for works of **commission.** In all the years of Canada's ascendancy the constructional interests have helped the country, and they have a right to expect some consideration at the hands of the country during a period of temporary decline.

In this there is no weak-kneed plea for charitable offerings; there is a straight, independent, unequivocal contention that the approaching completion of the Toronto Technical School suggests a line of activity which would benefit every man identified with constructional work, benefit the public, benefit the country and benefit the Empire. If it were known throughout Great Britain, and Australia, and India—in fact all over the world, that Canada had pioneered and financed an active policy of educational improvement—something on a scale sufficiently large to attract attention—the effort would be repaid a thousand-fold.

The chronic objector who condemns at sight everything that recalls the dollar sign will say that the schemes could not be financed in the first place and that the buildings could not be manned and equipped in the second. In both cases he is absolutely wrong. The combined governments of Canada, united in such a purpose, could find millions as easily as thousands. And by the time the buildings were completed—and long before, the country would have experienced a revival second to none in her history. We have the men, we have the money, we have the ships, and—which is greater than all—we have supreme confidence in the Empire. After Great Britain and her allies have reduced Germany to the national size of Montenegro there will be a flood of immigration to Canada which will revolutionize the country's business. The people of Canada have great opportunities and this is one of them.

The general aspect, then, of the new technical school at Toronto is by no means subsidiary to that which deals with features of design and construction, interesting though the latter may be. A study of the floor plans reveals a skilled layout, which cannot fail to be suggestive to those who have to do with future projects of this kind. The architectural symmetry of the structure, the materials employed, the accessibility of the building, the facilities provided, the mechanical installation—all these things will repay the constructional man if he goes into them in detail. But apart from this, and above all this, there is the feature of **example** which the country should not overlook.

Dominion Charters Upheld by Privy Council

THE recent decision of the Privy Council in the case of the John Deere Plow Company v. Duck, and Wharton v. The John Deere Plow Company, clears up, to a very great extent, a number of uncertainties which have surrounded the matter of Dominion and Provincial Companies' licenses ever since Confederation. The chief result of the decision is the establishing of the paramount jurisdiction of the Dominion over trade and commerce, making it definitely clear that a company which has secured a Dominion charter may carry on business in the various provinces of Canada without the necessity of taking out anything in the form of a Provincial charter. Manufacturers and other commercial companies operating in Canada who are well advised, will, as a result, henceforth take out Dominion charters and ignore Provincial licensing acts. In order to understand the situation clearly, it is necessary to refer briefly to the cases upon which judgment has been given by the Privy Council.

The John Deere Plow Company was incorporated under a Dominion charter, with head office in Winnipeg, and authorized to carry on business in agricultural implements throughout Canada. The case of the Company v. Duck was an action for breach of contract to accept delivery of certain implements which Duck had ordered, but afterwards refused to take, alleging that the Company, having no license in British Columbia, could not proceed against him. The Company claimed that its Dominion charter was all that was necessary to enable it to carry on business in any province. The case of Wharton was a friendly action asking for injunction to restrain the Company from carrying on business in British Columbia, on the ground that such business would be illegal because the Company had no Provincial license. Both cases were tried in the Supreme Court of British Columbia and decided against the Company. Appeal was then taken to the Privy Council.

The judgment is very sweeping and declares that the clauses of the British Columbia Act under consideration are invalid because they interfere with the powers conferred on the Company by the Dominion Parliament, and with the Company's status in the Courts. The judgment applies equally to the extra-Provincial licensing and registration acts in Ontario, Manitoba, Alberta, Saskatchewan, New Brunswick, Nova Scotia and the Yukon. The Act of the Province of Quebec specifically excepts Dominion companies, and is, therefore, unaffected. The Act of Prince Edward Island is of a different character, and is also unaffected.

Briefly, therefore, the situation is as follows:—

To do business throughout Canada a Dominion charter alone is necessary.

A Provincial license enables a company to do business in the province from which the license is obtained. Whether a Provincial license enables a company to do business outside of the province issuing the license, is still unsettled, and is under consideration in connection with a case shortly to come before the Privy Council.

A province can no longer compel a company with a Dominion charter to obtain a Provincial license or to be registered in the province as conditions of exercising its powers or of suing in the Courts.

The rights of the provinces to enact laws affecting the general public in the provinces and relating to civil rights, or taxation, or administration of justice are not affected.

The opinion of the Privy Council is definitely ascerted in the following references to the provisions of the British Columbia Companies' act which were under discussion:—"Their Lordships think the legislation in question really strikes at the capacities which are natural and logical consequences of incorporation by the Dominion Government of companies with other than Provincial objects."

The Part of the Engineer in the Community

IN his Presidential Address, delivered on December 3rd, before the Regina Engineering Society, Mr. L. A. Thornton (City Commissioner), insisted that engineers should pay more attention to the draughting of legislation than they were doing. He contended that they should have more to say in regard to the manner of expending money on public improvements. Mr. Thornton referred particularly to the large amount of money that had been lent to Canada by the Old Country, and showed how most of this money had been spent upon constructional work which had come under the practical supervision of engineers.

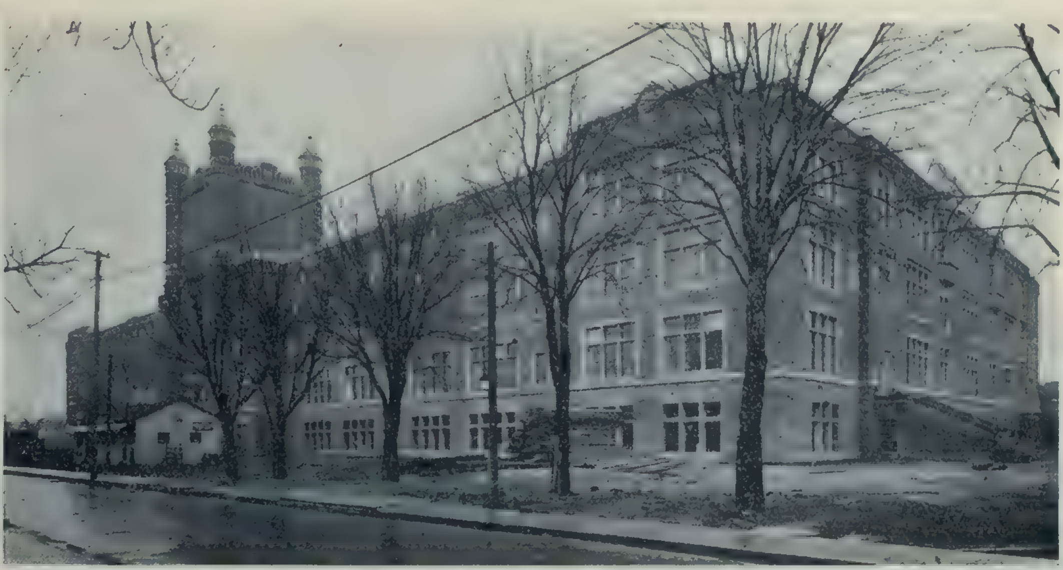
Tracing the history of the city through all its changes, the speaker pointed out how such a history constituted the history of the race which inhabited the city and the surrounding country. In the history of civilization, Babylon was one of the earliest municipalities.

Continuing to the point of making mention of certain Grecian and Roman cities, Mr. Thornton came down to the city of to-day, and discussed the part of the engineer in its activities. Engineers were interested in practical work, and legislation of many kinds might be traced to their influence.

New York City's debt was one-third of the total debt of the United States Government, and more than one-fourth of it had been incurred upon improvements.

Mr. Thornton discussed the commission form of government, and while commending it, qualified his commendation by showing its dependence upon personality.

The speaker suggested that future meetings of the society should take up for discussion such important questions as systems of taxation and forms of government.



The Central Technical School, Toronto, upon the completion of the exterior.

The Design and Construction of the Central Technical School, Toronto

(Staff Article)

THE new Central Technical School at Toronto, which is now well advanced towards completion, contains features of outstanding interest in regard to design and construction.

The site is practically level and takes up two entire city blocks, measuring 813 ft. x 300 ft. The building itself measures 425 ft. x 212 ft. It occupies the centre of the site, the main elevation facing west on Lippincott street. The rear elevation overlooks Borden street; the north, Lennox street; and the south, Harbord street. To those acquainted with the city plan of Toronto, the accessibility of the building from the street car lines will be apparent.

Building operations were commenced on May 1st, 1913. Progress in the interval has been so marked that it is fully anticipated that the work will be completed in the allotted time, that is to say, by next May.

The excavation for the sub-basement was quite an undertaking in itself. The building is set on extremely hard clay. Below the basement floor this clay became so hard that dynamite had to be used: Practically no water was met with in the excavation. The structure is resting on a hard, compact and dry foundation.

Concrete work was started about July, 1913, and most of the foundation walls were in before the arrival of the extremely cold weather. During December the main walls had been brought well above grade, but owing to the severe frost the brick work had to be stopped for a period of about three months. Operations were renewed at the end of March, 1914, when the steel work was got under way. This part of the structural operations was completed about the middle of June. The brick work followed very quickly. The roof was completed and the building rendered watertight during the month of September. At present the building is in process of drying out for the finished carpentry work.

The building is of three storeys, with high basement, the floor level of the latter being only four feet below grade. The main entrance is surmounted by a large square tower, standing 120 ft. above the street level. Generally, the building may be said to comprise four component parts. The basement covers the entire area of the building and is devoted solely to workshops. Above the level of the basement two large courts appear, each about 120 ft. x 90 ft., leaving the second and third parts, viz., the north and south series of class rooms, beautifully lighted both from the front and from the courts. The fourth component part is the central portion which is occupied by a large auditorium with the construction room in the rear. The gymnasium and plunge-bath are placed below the auditorium, additional class-rooms, devoted to architectural drawing, being located above.

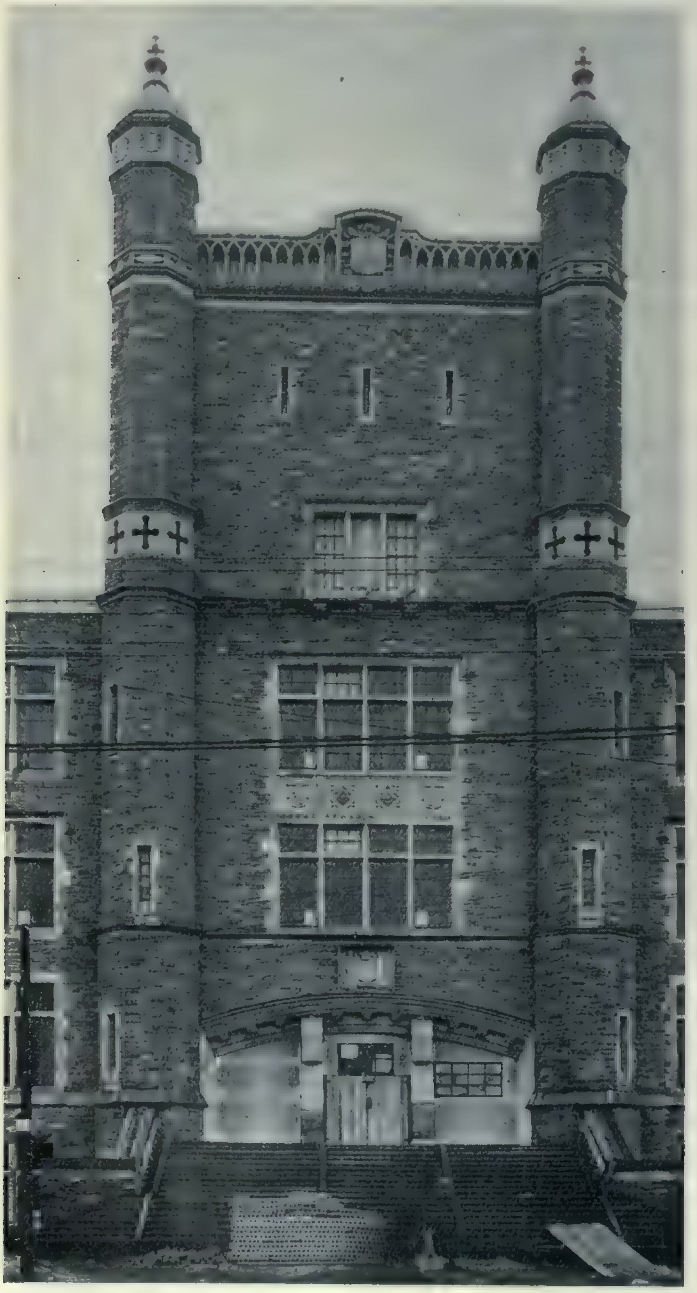
The style of architecture is simple and plain, it being Gothic in character, with English feeling. There have been slight modifications of the floor plans since their preparation, but the general principles have remained constant.

The main walls to all four elevations are constructed in Scotch snecked rubble with Credit Valley stone. A warm and pleasing effect was obtained by the use of 80 per cent. piebald stone and 20 per cent. pure grey. The stone trim to all window and door openings is Indiana limestone. The cope and part of the ornament of the tower is in terra-cotta. The court walls are Don Valley buff pressed brick.

Bare wall construction is used everywhere, except in the central portion of the building, where a steel frame was necessary to span the auditorium.

The sub-basement at the rear is an interesting building in itself. The floor is 27 ft. below the sidewalk. In this portion there is located a spacious engine room, boiler room, pump room, fan room, and coal pocket, with engineer's quarters so situated as to command a view of the engine room. The basement, as already stated, is set apart for the accommodation of workshops. Each room is devoted to a separate trade. The walls are of pressed brick and the floors are finished in cement, specially hardened to withstand the traffic. The ceiling height here, as elsewhere, is 14 ft. 6 ins. in the clear. These workshops were laid out with a special view to obtaining good light, and the desired results were achieved in all of the seventy rooms on this floor.

Centrally located in the rear of the basement is the construction room, which is 36 ft. x 80 ft. in dimensions. This room has a 30-ft. ceiling. Here it is intended to carry on at one time the erection of two full-sized houses, in which work students from the various workshops will participate. Leading off from the First Floor corridor is a Visitors' Gallery in connection with this room.


Detail main entrance, Central Technical School, Toronto.

The corridors in the basement are typical of the building. The floors are terrazzo and the walls pressed brick, of a light buff color. A little relief is afforded by a 4-ft dado of a darker colored brick. The ceilings are furred and plastered in the form of an arch, with a height at the crown of 12 ft. The main corridors are 120 yards long by 10 ft. wide. No wood trim appears in connection with these corridors. All openings are finished with bull-nosed brick and the door frames are set well into the openings, this resulting in a clean, trim-looking corridor.

In the basement also are the gymnasium and running track, with shower baths and dressing rooms leading off. The plunge bath is finished in ceramic mosaic tile.

Large assembly rooms, bicycle rooms, and locker and toilet accommodation are provided at either end of the basement. There are six entrances to this floor —two on Borden street, two on Harbord street, and two on Lennox street.

Passing on to the First Floor, we have the main entrance on Lippincott street and two entrances on Harboard street. The main entrance, steps and platforms are made entirely of local stone, from the Credit Valley works. The main arch at the entrance and all of the stone work in the loggia are in Indiana limestone. Double sets of swing doors lead into the main hall, which is finished in glazed terra-cotta. The main corridors run off to the right and left, while in front is the main stairway, finished in marble work, leading up to the main auditorium. This stairway extends to the second floor from which level entrance is had to the gallery of the auditorium. This room has a seating capacity of about 1,800. It is finished in red oak panelling, with a lofty, ornamental ceiling, the combined effect being most attractive.

This auditorium is the only room in the building where the plain, severe treatment is departed from, ornamental work having been introduced to enhance the general appearance. At the west end of the auditorium there is a large rostrum and provision has been made here for the installation of an organ. Large casement windows, of Hope sash, which light the auditorium from both sides, are a feature. The dimensions of the auditorium are—length, 100 ft., and width, 80 ft., with a ceiling height of about 38 ft. The corridor leading off the main hall to the north end gives access to the Principal's Room, the Board Room, a series of class rooms and a large Exhibition Room. On this floor there is a smaller lecture theatre, with a seating capacity of over two hundred, which will be used for students as well as for public lectures. Steel cabinets, in accordance with the Underwriters' requirements, are provided for moving picture operations.

Leading off to the south of the main hall the corridor gives access to a large reading room and a series of physical laboratories, mathematical laboratories, and general class-rooms. All these rooms will be fully equipped. In structural design and treatment the corridors of these floors are similar to those in the basement. Both the corridors and the class-rooms are flooded with light—a feature of the building which formed a special study of the architects.

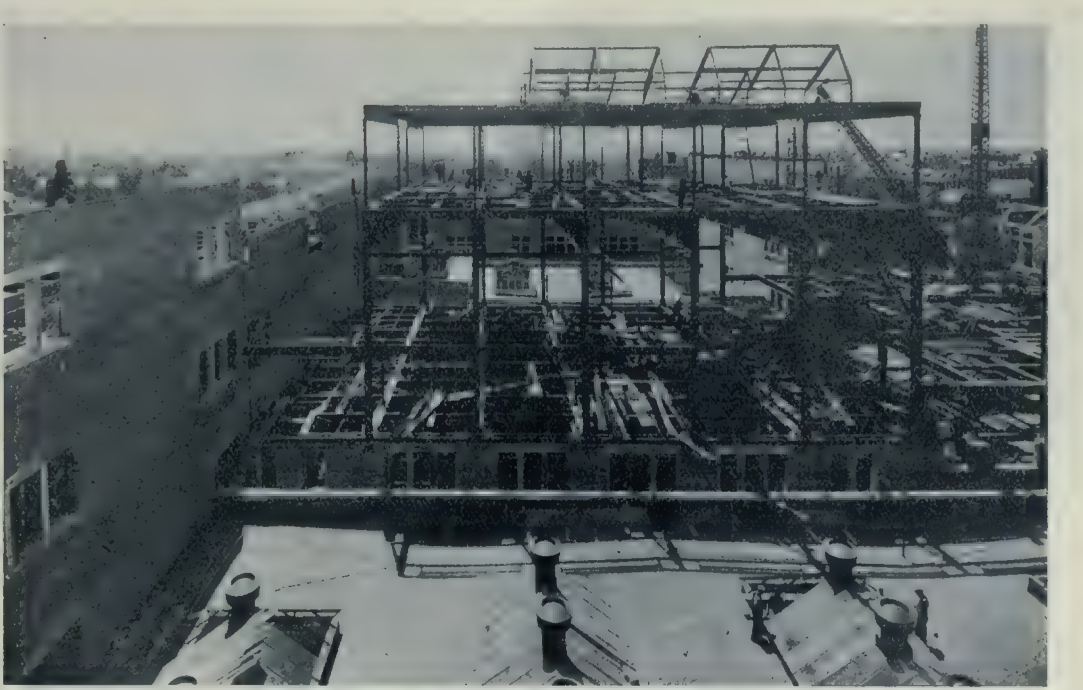
The Second and Third Floors are, in the main, a repetition of the First Floor so far as the layout is concerned. The Second Floor is devoted almost entirely to women students, where the two departments of Domestic Science and Domestic Art will be carried on. In the north-west corner of this floor there is constructed a model apartment consisting of dining room, kitchen, servants' room, servants' pantry, bedroom and linen cupboards, the intention of the authorities being

Excavating for sub-basement, Central Technical School, Toronto. Photo taken October 31, 1913.

to demonstrate the rudiments of Domestic Science. On the same floor is a large laundry, which will be equipped with modern machinery, bacteriological laboratories and millinery workshops. A large lunch room, with kitchen adjoining, is provided for the male students, and another, of smaller dimensions, for the women students.

The Third Floor contains another series of class-rooms. The south end of the building is devoted to chemistry, with metallurgical laboratories for quantitative and qualitative analyses, also for elementary and applied chemistry. Each department possesses its own lecture room, with a preparation room behind, and ample locker and toilet accommodation. In the centre of the building the class-rooms are devoted to art, where object drawing, clay modelling, architectural and free-hand drawing will be carried on. The north end of the building is allotted to engineering and mechanical drawing.

In all there are about two hundred and seventy rooms in the building. The typical room is 28 ft. 6 ins. wide and on an average about 50 ft. long, with a ceiling height of 14 ft. 6 ins. The windows throughout are Hope sash and on a transverse section of the main wall 43 per cent. is daylight opening. Owing to this fact it was necessary to make these exterior walls half a brick thicker than is called for under the Toronto building by-laws. Each room is ventilated mechanically from a power plant in the basement, the supply and exhaust matter being led to each individual room.



Steel work, auditorium section, Central Technical School, Toronto.

Vacuum cleaning outlets are being provided in each room and the heating is controlled thermostatically.

In each room there are sliding and stationary blackboards. Over one mile of blackboards will be provided throughout the building.

The lecturer's platform is 7 in. above the main floor level. It has a 12-ft. table, fully equipped with electric power outlets—gas, compressed air, hot and cold water, and, where necessary, vent ducts for drawing off fumes.

In the physical and chemical departments the tables allotted to individual students, as well as the lecturer's table, are provided with the above equipment.

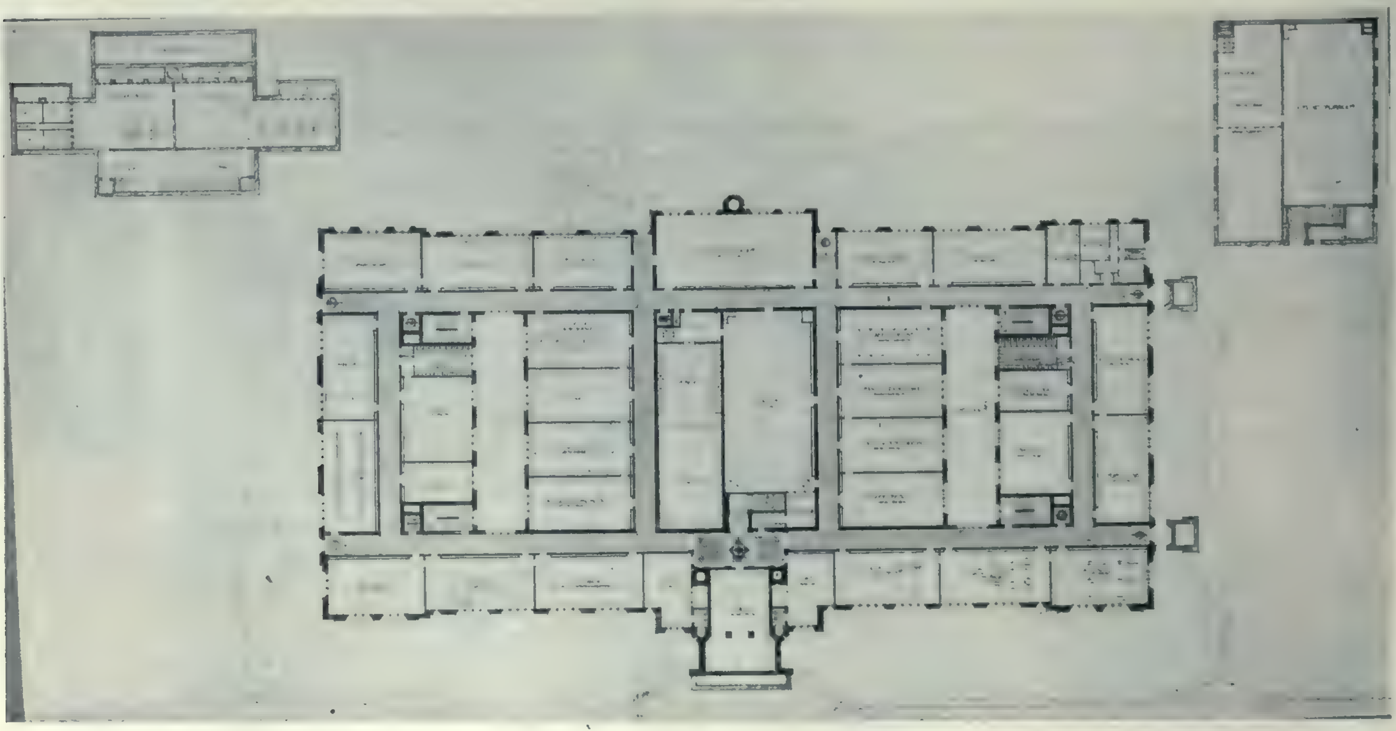
At each corner of the building, leading directly into the corridor, there is a fire stair enclosure, equipped with the usual Underwriters' doors, and on the exit doors, immediately adjacent, fire stair doors will be equipped with panic bolts. On each corner facilities are provided for passenger elevators. At present only one is being installed—in the south-west corner. There is a freight elevator at the rear.

The mechanical installation in this building, which is under the supervision of the Canadian Domestic Engineering Company, will be one of the finest in Canada. The building will be heated and lighted and all power supplied from a 750 h.p. Babcock & Wilcox installation. It will have its own generators in the engine room, supplying light and high tension current for power. Air compressors are provided for supplying the various lavatories, and a refrigerator system for experimental purposes is also being installed.

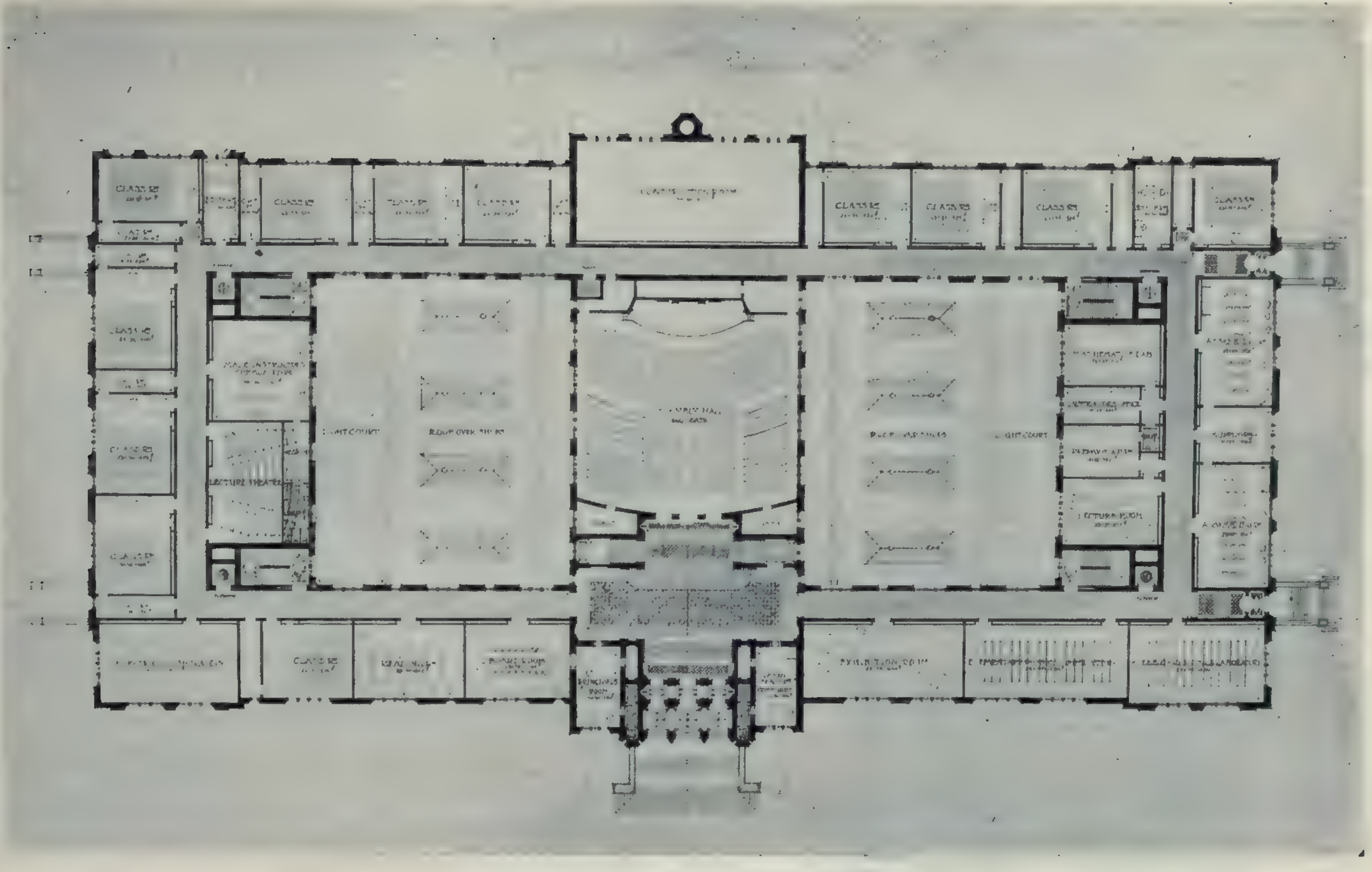
The heating is the single-pipe force hot-water system and over and above this the air passing from the ventilating system is tempered before it reaches the rooms. The air is brought into the building through a large fresh-air duct leading to the sub-basement, about 25 ft. x 10 ft. in cross-section. The air is first heated in a large vento, then passed through air washers and re-heated, two large Keith fans forcing it through the pipe tunnels. The ventilating system is in duplicate, the north half of the building being entirely separate from the south. The pipe tunnels run below the basement floor and encircle the whole building. From these tunnels galvanized iron ducts rise throughout the building. These ducts are again gathered at the roof and brought into two large exhaust boxes immediately behind the tower in the centre of the building. In the pipe tunnels radiators and deflecting plates are provided at intervals, so that the amount of air admitted into the room can be regulated to a nicety. A small continuous filtration plant is provided for the plunge bath in order that the water shall be pure at all times and not have to be drawn off at intervals.

The remainder of the equipment in the building—more particularly the equipment in the various shops in the basement—will form the subject matter of a later article.

The building contains approximately 400,000 ft. of porous terra cotta fire-proofing, upwards of 2,000,000 pressed bricks of different shades of buff, more than 7,500,000 common bricks, and a large quantity of enamelled bricks of special sizes used in the corridors. This material was manufactured and supplied by the Don Valley Brick Works, Toronto. The sand and gravel in the building were supplied by the York Sand & Gravel Company, Limited. The general contractors are the Norcross Brothers Company. Other contractors on the work are: plumbing, Fred Armstrong Company, Limited; electric wiring, Keiths Limited; elevators, Turnbull Elevator Manufacturing Company; structural steel work, Dominion Bridge Company, Limited; Credit Valley stone and mason work, Messrs. Rees & Hawken; Barrett Specification roofing and waterproofing, Canadian Supply & Contracting Company, Limited; metal sash, Henry Hope & Sons, Limited; Indiana limestone, Messrs. Geo. Oakley & Son; architectural terra cotta, Federal Terra Cotta Company, New York; painting and glazing, Hughes & Company; plastering, Mr. R. C. Dancy; sheet metal and calamine work, W. E. Dillon Company, Limited;



Basement plan, Central Technical School, Toronto.



First floor plan, Central Technical School. Toronto.

ornamental ironwork, including Modern Method stairs, Canadian Ornamental Iron Company, Limited; glazed terra cotta in interior, Northwestern Terra Cotta Company; heating and ventilating, Canadian General Fire Extinguisher Company, Limited; interior finish, Oshawa Interior Fittings Company; red oak doors, Compound Door Company, St. Joseph, Mich.; tables for equipment, Berlin Interior Hardwood Company; electrical work in connection therewith, A. B. Rice Company.

The structural engineering work was designed by the Structural Engineering Company, Montreal, in conjunction with the architects, Messrs. Ross & Macdonald, of Montreal and Toronto.

The cost of the building in round figures is $2,000,000. The site involved an outlay of $350,000. The building lone will cost about $1,400,000 and the equipment some $250,000.

C.P.R. Freight Terminals at Quebec

FROM designs prepared by the Building Construction Department of the C. P. R., Mr. W. S. Downing-Cook, of Montreal, is erecting at Quebec a system of fine freight terminals, under the direction of Mr. D. H. Mapes, Superintendent of the Company's Building Construction Department. There are two sheds, one for inbound and the other for outbound traffic; the foundations of these are on Raymond concrete piles, the floors being built of reinforced concrete, with the structure supported by steel rafters and girders. The inbound shed is 50 ft. wide by 600 ft. long, and the outbound shed 30 ft. wide by 400 ft. long. They are both constructed on the unit system, which allows either or both to be lengthened by the addition of other units. A transfer platform will be installed between the sheds, while the tracks are laid in such a way that freight cars may be shunted alongside both platform and shed. The arrangement of the sliding doors is novel, and will afford great convenience to merchants. These doors will be continuous the full length of both the track and roadway sides of the sheds, and will give an entrance at any desired point, thus facilitating the work of loading and unloading and saving considerable time.

The sheds will be fronted with a two-storey office building, 50 x 100 feet, for the staff, and through this access to the sheds may be gained. The buildings and sheds will be lighted with electricity. The contract will be finished by the middle of April, when it is proposed to commence the erection of the new union station of the C. P. R. and Tarnscontinental. This will necessitate the demolition of the old freight building. The new freight terminals will cost about $250,000. The steel work was designed by Mr. P. B. Motley, Engineer of Bridges, C. P. R.; Mr. S. G. Newton is superintendent for Mr. W. S. Downing-Cook. The steel is furnished by the Dominion Bridge Company, of Lachine; Douglas Bros., of Montreal, have the contract for the roofing and doors; the painting is being done by Schulmerich & Company, Montreal; and the brick work is let to the Citadel Brick Company, of Quebec.

Tests on thermit welded pipes from 1 to 1¼-in. in diameter, made by Prof. Frederick L. Pryor of the Stevens Institute of Technology, have shown that the tensile strength at the weld is practically the same as for straight pipes without joints and considerably higher than the strength of standard threaded sleeve couplings. Subjected to bursting tests all specimens ruptured in the seam of the pipe.

Recent Practice in Bituminous Construction and Maintenance[*]

By Wm. D. Uhler[†]

MANY perplexing problems arise in the construction of bituminous pavements, especially on streets occupied by railway tracks, where many failures occur alongside and between the rails due, in most cities, to old agreements, contracts, etc., which prevent the authorities from compelling the railway companies to reconstruct their tracks in accordance with the present-day standards. For instance, in Philadelphia, with few exceptions, practically all of the trolley tracks are ballasted with the natural soil, which is a sandy loam. This not being a rigid construction, there is more or less movement of the rails, which damages the pavement. The ideal construction, from the standpoint of the paving, is to place concrete under the ties, and it is usually found advisable, as well as more economical, to place runners of at least one row of blocks on either side of the rails to take the shock and extra wear caused by heavy traffic turning on and off the tracks. There is a difference of opinion among engineers as to the character of blocks best suited for this purpose—scoria, vitrified, wood and granite blocks are used largely—but experience indicates that the most satisfactory results are obtained from the use of close fitted granite block runners, bedded in the green concrete, and well grouted.

The Author, Mr. Wm. D. Uhler.

Philadelphia's specifications for sheet asphalt are substantially the same as those adopted at Pittsburgh in 1913 by the Association for Standardizing Paving Specifications. The Country Road Bituminous Specifications include the so-called patented pavements—Amiesite, Filbertine and Warrenite, and a Bituminous Concrete somewhat similar to the Topeka mixture. Each bidder can bid only on one type of pavement, and the work is awarded to the lowest bidder, irrespective of the type bid on, the pavements being in competition with one another.

The following are abstracts from these specifications which show the mineral aggregate and the percentage of bitumen used in each pavement.

Amiesite

The mineral aggregate shall be clean, crushed trap rock of approved quality, the maximum to pass a 1½-inch ring and so graded as to produce the densest mixture. The mineral aggregate shall be treated with a liquifier to make the asphalt adhere. The asphalt heated to about 275 degrees shall then be added and after the mineral aggregate is thoroughly coated, oxide of lime shall be added. The ingredients referred to above shall be mixed by weight in the following proportions: mineral aggregate, 92 per cent.; asphalt, 5 per cent.; lime, 1½ per cent.; liquifier, 1½ per cent.

Filbertine

The mineral aggregate in the Filbertine mixture shall be within the following proportions best suited to make the densest mixture: ¾-inch stone, hard crushed, 55 to 65 per cent.; sand, coarse to fine, 35 to 45 per cent.; mineral dust, 4 to 6 per cent.; asphalt cement, 6 to 8 per cent.

Warrenite

The stone, with or without the addition of sand, graded in the following proportions so as to give the wearing surface the greatest degree of density, rigidity, inherent stability and freedom from voids: material passing 1¼-inch screen and retained on a No. 2 sieve, 40 to 60 per cent.; material passing No. 2 sieve and retained on a No. 4 sieve, 10 to 20 per cent.; material passing a No. 4 sieve and retained on a No. 10 sieve, 10 to 5 per cent.; material passing a No. 10 sieve and retained on a No. 30 sieve, 10 to 5 per cent.; material passing a No. 80 sieve, at least 25 per cent. of which will pass a No. 200 sieve, 10 to 5 per cent. The balance to pass a No. 30 sieve and be retained on a No. 80 sieve.

From 5 to 10 per cent. of Warrenite cement as directed sufficient in quantity to coat each particle and fill the voids remaining between the stones.

Bituminous Concrete Specification

The finished pavement shall contain between 8 per cent. and 11 per cent. of bitumen, depending upon its composition, but in all cases, sufficient asphaltic cement shall be used to thoroughly coat all the particles of the mineral aggregate. Fine mineral aggregate shall be proportioned by weight as follows: Portland cement or stone dust passing No. 200 sieve, 10 to 15 per cent.; sand, passing No. 80 sieve, 18 to 36 per cent.; sand, passing No. 40 sieve, 20 to 40 per cent.; sand, passing No. 10 sieve, 8 to 25 per cent.; sand, passing No. 4 sieve, up to 10 per cent.

With this fine graded aggregate, there shall be used a proportion of clean, hard limestone with a co-efficient of wear of not less than 10, or trap rock chips with a co-efficient of wear of not less than 15, all of which will pass a ½-inch screen and be retained on a No. 10 screen, amounting to approximately 25 per cent. of the whole aggregate.

It might be well, in this connection, to state that paving authorities, when admitting in competition any of the proprietary or patented pavements, should insist upon a full and complete specification for each of the types in question, so that when a pavement is laid, the engineer will have sufficient knowledge of the materials comprising the pavement to enable him to control its construction. No pavement of any character is laid in the city of Philadelphia unless information is furnished; first, as to the quality and proportion of the material to be used; second, the preparation of the mixture at the plant; and third, the proposed method of laying the mixture on the prepared foundation.

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[*] Paper presented at the Annual Convention of the American Road Builders' Association held this week at Chicago.

[†] Principal Assistant Engineer, Bureau of Highways and Street Cleaning, Philadelphia.

In the preparation of the mixture all materials are subjected to rigid plant and laboratory inspection. During the actual operation, inspectors, with engineering education or training, are assigned to each asphalt plant, to inspect as far as can be done at the plant, the raw materials as to quality and mechanical grading of the sand, crushed stone and mineral filler or stone dust, and daily samples representative of the materials used and mixtures made at the plant are sent to the central laboratory where they are tested, and the results filed as a permanent record of the pavements laid.

The specifications stipulate the penetration of bitumen and temperature within limits sufficiently wide to cover all conditions, but definite instructions covering these two points and based on the amount and character of traffic are given to the inspector for each contract.

The foundation having been laid to true line and grade, the next step is to obtain a correct and uniform depth of binder and wearing surface, raked to a true cross section and grade, after which it must be thoroughly rolled; and without doubt the most important single point in the laying of bituminous wearing surfaces is the question of rolling. More pavements are failing today through displacement from their original form than from all other causes combined, and aside from the other reasons to which this result may be attributed, and there are undoubtedly many, it is certain that unless a pavement is free from waves at the time of its completion, it never will be, as the tendency of the pavement is to push under traffic which increases the wavy condition. It is important, therefore, that all pavements be thoroughly compressed, carefully rolled and cross rolled, with properly maintained rollers operated by skilled roller engineers. It has been the practice in some cities to use only one roller, but far better results can be obtained by using a light roller for the initial compression and a heavier roller for the final compression. The best results obtained in Philadelphia have been by an equal amount of transverse and longitudinal rolling with a 2½-ton roller, followed by an equal amount of transverse, longitudinal and diagonal rolling with an 8 or 10-ton roller.

In the laying of sheet asphalt or bituminous concrete, where brick gutters are used and adjacent to block runners along car tracks, it is good practice to lay the finished surface of the pavement from one-eighth to one-quarter of an inch higher than the brick gutters or runners. It is difficult in the rolling to secure final compression next to these blocks, and traffic will further compress that portion of the pavement, naturally causing the development of low spots which hold water and result in deterioration.

It is questionable whether, as compared with the old so-called open binder, the latest specification for the binder course which calls for a grading of stone from 1 inch diameter down, with the addition of 25 to 35 per cent. of sand, producing a mixture with greatly reduced voids, does not result in giving a decreased mechanical bond for the wearing surface, and whether, in view of the possibility of the top shifting under traffic, it might not be advisable to use the open binder exclusively.

In the grading of the mineral aggregate, special attention must be paid to the percentage and penetration of the asphaltic cement which, of course, is dependent upon the asphalt used, climatic and temperature conditions, and the character and amount of traffic.

The following is the present practice in Philadelphia under average conditions:

Philadelphia Surface Mixtures, 1914

Traffic Conditions:	Light	Medium	Heavy	Patching
Per cent. Bitumen...	10½	10½	10¾-11.0	10¼
Penetration:				
Mexican	60-65	50-60	45-50	50-55
California	60-65	50-60	45-50	50-55
Bermudez	60-65	50-60	45-50	50-55
Trinidad	55-60	45-55	40-45	45-50

Note:—Bitumen figures varied slightly from the above to take care of unusually fine or coarse sand.

Bituminous Macadam Penetration Method.—In penetration work, after the base has been prepared, and clean, approved hard stone has been spread to the required depth, the recognized practice is to use from 1¼ to 1½ gallons per square yard of bituminous material conforming to the specifications. Then after chipping and rolling, a flush or seal coat is applied of from ¼ to ½ gallon per square yard and another application of chips, before the final rolling.

The tendency has been to discontinue this method of construction, where it is practical to use the mixing method. Although it is an admitted fact that the penetration method is slightly cheaper than bituminous concrete in first cost, when the life and maintenance of the respective pavements are taken into consideration, it is doubtful whether the penetration method is not more costly than the mixing method.

There probably 'has been more deterioration in roads built by the penetration method than in any other modern type of construction. Generally speaking, this is due to too much personal equation entering into the work, as, for instance, unequal distribution of binder, resulting in the formation of waves and ruts which always grow worse under traffic. The method of heating the binder is not as easily controlled as in a mixing plant and often results in overheating, causing weak spots in the pavement. Even if the method of construction were more ideal, it is questionable whether the penetration method should be used, as at the present time there are on the market a number of portable mixing plants of all sizes that would be practicable in most sections of the country, and it is generally conceded that the mixing method is preferable to the penetration, provided first cost is not the dominating factor.

Bituminous Pavement Mixing Method.—The specifications in the city of Philadelphia are as definite and rigid in their stipulations covering the preparation and laying of bituminous concrete pavements as they are in the case of sheet asphalt. All these pavements are now being laid on a 4-inch concrete base instead of on an existing macadam foundation, which heretofore has been the generally accepted practice on country roads. In view of the increased amount and change in character of the traffic, even though slightly more expensive, it has been considered advisable to provide for a 4-inch concrete base on top of the broken stone or Telford base, due to the tendency of the macadam base to shift or further consolidate under traffic and possible sub-grate trouble, all of which tend to bring about a wavy or uneven surface.

In resurfacing old waterbound macadam roads, where the road consists of either telford or macadam base, the broken stone surface is removed to a depth sufficient to conform to the required cross section and grade. Where the telford surface is exposed the irregularities are broken off with a napping hammer and the depressions filled in, and upon this prepared surface is placed a 4-inch concrete base, mixed in the proportions of 1:3:6, so laid as to secure a very rough but regular surface to form a bond between the concrete base and the bituminous top. In conjunction with the concrete base a concrete header curb is constructed extending 6 inches beyond the fixed edges of the bituminous pavement and to the finished grade. After the concrete base has developed a hard set, and from one to two days prior to the placing of the bituminous wearing surface, the base is thoroughly cleansed of loose and foreign material, by sweeping, and is then covered with an asphaltic cut-back mixture consisting of equal parts by volume of asphaltic cement, 55 to 65 penetration, and commercial naphtha, 52 to 55 gravity; the mixture being supplied by a pressure distributor at the rate of ⅛ gallon per square yard. The object of this paint coat is to secure a better bond between the concrete base and the bituminous top. The bituminous top, 2 inches in thickness, is laid under the same requirement as to preparation, laying, rolling and inspection as for sheet asphalt. Where a new pavement is laid on the earth sub-grade a 5-inch concrete foundation is used.

One of the important features in connection with obtaining the best results in bituminous concrete construction is the use of good, hard, durable stone, free from dirt and decomposed material, in the wearing surface, as decomposed stone in the mixture will naturally develop weak spots in the pavement, ultimately resulting in failure.

The following penetrations are used in Philadelphia:

	Heavy Team or Motor Traffic Penetration	Medium or Light Traffic Penetration
Trinidad Asphalt	40-50	50-55
Bermudez, Mexican and California.	50-55	55-60

There always has been a tendency to slight or overlook details in this class of work, and as an illustration the following is quoted from the Fourth Annual Report of the Association for Standardizing Paving Specifications, 1913: "In the case of a park driveway or a suburban highway, a bituminous concrete pavement may be successfully used without a curb; no other protection for the edge of the pavement is required except to provide a coarse, grainy surface into which the paving material is rolled." There is no question but that this was the generally accepted practice at the time this report was made. Later experience, however, has demonstrated that this method of construction might answer for wide roads with light traffic, but where the width of the paved surface is 18 feet or less, the turning of traffic on and off the bituminous surface will result in grinding or cracking the edges and also, unless a perfect bond has been secured with the base—and this cannot be relied upon—heavy wheel loads, at a distance of 1 to 2 feet from the edge, will produce a spreading of the bituminous surface. To obviate this, provision is made in the Philadelphia country road specifications for a 6-inch concrete header curb on either side of the road where the road is not paved to the full width.

The idea that the introduction of stone into the bituminous mixture is a cure for all the troubles which have developed in recent years with sheet asphalt, is wrong. Topeka and later specifications developed from it, calling for about 25 per cent. of ½-inch stone, cannot be considered ideal bituminous pavement, as the stone is not sufficient in quantity or size to produce the interlocking required for stability in the mineral aggregate. In laying this type of pavement the segregation of the mixture in pockets of fine and coarse material, will produce a pavement with irregular wearing qualities, unequal compression and unequal ability to resist displacement by traffic; with the use of stone in large quantities a much more stable pavement is secured, but an element of danger is introduced with the use of large stone, in the mixing and laying, brought about by the segregation of the large and small sizes of stone, with the result that the pavement will not be as uniform in character as is the case with a standard sheet asphalt pavement.

Maintenance of Bituminous Pavements.—We all know the success of any pavement depends on the maintenance, and the success of maintenance depends largely on attention to details, for instance, in cutting out the old material and cleaning the base, placing the new material, rolling, etc. Judgment and experience are necessary in determining the extent of the work to be done and the amount of material to be cut out for each individual patch. A patrol maintenance system will do more to preserve roads and pavements and prevent deterioration than any one thing.

There are two methods that can be considered for the maintenance of bituminous pavements by contract; first, by the square yard, and second, on the tonnage basis. Working on the square yard basis, there is more or less of an element of chance taken by the contractor as to the depth of binder and top to be laid, due to the age and unequal wear of the pavement, and as the binder is naturally the cheaper, the contractor is apt to increase the depth of the binder and decrease the depth of the top. On the tonnage basis, due to the fact that the price bid for the binder is usually about one-half that for the top, there is a tendency on the part of the contractor, unless the work is closely inspected, to cut down on the amount of binder and to increase the amount of top. Thus in the two methods the case is reversed. On the tonnage basis, however, since payment is made only for the actual amount of binder and top used there is really no "gamble" on the part of the municipality or the contractor as to the amount of each class of material to be furnished, which is the case on the square yard basis. It is, however, more desirable for the city to own an asphalt plant as this class of work can be handled more satisfactorily by municipal forces than by the contract system.

In order to assist in solving many of the perplexing problems arising in connection with paving work, it has been found advisable to build experimental and service test roads. If this practice had been consistently followed the result would be that we would not have the extensive failures we have had through the use of untried materials and methods of construction, which should have been tried out experimentally on a small scale such as was done in Maryland on Park Heights Avenue, built in 1910; and the White Plains experimental road, Borough of the Bronx, New York, built in 1910. A Service Test Roadway such as built in Philadelphia in 1912-13; and Second Avenue, New

York, built in 1912, which comprise more or less standard methods of construction and materials, should be of great value in compiling permanent records of the comparative value of the different types of the present-day standard pavements. Work of this kind should be encouraged as it will ultimately result in solving many of our paving problems. Detailed information relative to Park Heights Avenue, White Plains Road and the Service Test Roadway has been published in report form and distributed to the public, but, up to the present time, no information has been available with reference to the Second Avenue work. It is hoped, however, that these data will be made public in the near future.

If we are to arrive at any solution of our troubles, it behoves all of us to be frank and, instead of coming to the various road conventions and telling of the successes, we must come to the front and tell of the failurea, as it is an indisputable fact that every State or Municipal officer here today is having his failures. This being the case, why not give the "other fellow" the benefit of your experience? If this thought were carried out there would be less failures.

*Note.—"Equal parts by volume" may be said to be 58 to 60 per cent. by weight of asphalt and 42 to 50 per cent. by weight of naphtha. This is not definite, as we should have specified equal parts of melted asphalt.

The Disposal of Trades Waste*

By J. W. Sheridan

IN treating a subject in a paper such as this, it is necessary to keep within certain limits as to length. It cannot be hoped, then, to go fully into all the aspects of the matter under consideration, or even to do justice to the points actually raised. Under these conditions the object of the paper will be attained if a certain amount of interest in regard to the various difficulties and questions arising out of and surrounding the disposal of Trades Waste is aroused amongst the members of the Society. It is in the hope, therefore, of opening up an interesting, and not very widely discussed side of sanitary engineering to the consideration of the Society that this paper is submitted.

Many things enter into the disposal of Trades Waste: engineering, mechanical and civil; bacteriology; and chemistry, to mention but a few. Chemistry and bacteriology are, perhaps chiefly concerned with the recovery of useful matters from the waste; either such as can be re-used in connection with the industry producing the waste, or such as may be useful in some other way; manurally for example. In both these cases the cost of recovering the useful portion of the waste must, other things being equal, be justified by the amount and value of the useful agent recovered. Engineering knowledge is required in this connection for the carrying into effect of the chemist's or bacteriologist's ideas as to the recovery of the useful parts of the waste in suitably designed and constructed recovery plants. It is also necessary in making provision for the ultimate disposal of the useless parts of the waste, in such a way that they may create the least possible nuisance to the community which might later be affected by such wastes.

Equity may also have something to say in the matter, and may demand two things, the one, that the industry from which the waste arises shall not be unjustly hindered with the necessity of a superfine purification or a two exactive disposal of its waste. The other that the community or communities naturally or artificially affected by the existence of the industry, in whatsoever way, shall be properly safeguarded from the abuse of their natural rights that might arise from the existence of the industry and the waste arising therefrom.

It is the intention of this paper to touch to a greater or less degree on each of these salient points with regard to the disposal of trades waste. No one of them is of less importance than the others, and they are, indeed, to a great degree interdependent, and must be considered so especially by the engineer, who as a kind of modern jack-of-all-trades—though it is to be hoped not "master of none"—should have a smattering of all matters touching his profession, and should also have the faculty of seeing their relative values in true proportion.

Treatment or Purification

The first question that arises in connection with the disposal of Trades Waste is: When does trade waste require treatment or purification before being turned into the nearest sewage carrier? The answer to this question will vary in each individual case. When a manufacturing industry is situated on a seaboard there may or may not be a necessity for purification. If situated on a tidal estuary the shoals of which are densely populated some effluents will certainly require to be purified. The necessity for treatment, will however, be dependent on many considerations. The quality and quantity of the effluent may perhaps be the most important of these, but some others of equal importance can be named, e.g., the character of the bottom; the value of the fishings likely to be affected, especially in the case of oysters and some other fish beds in the vicinity of the outlet; the velocity of the ebb and flow of the tides, and the directions of the currents at all states of the tide. Similar conditions affect the disposal of trades waste discharged into rivers and lakes. The quantity and composition of the effluent and its likely effect upon the stream or lake must be carefully gone into before a decision is arrived at as to the amount of purification, if any, required before its discharge.

In the same way where trades waste discharges into a common sewer of a public authority its possible effect upon the sewers and purification plant of the authority should be considered, and the more so that the discharge of trade effluents into common sewers is a frequent source of difficulties arising between the manufacturer and the public authority.

The polluting effect of trades waste arises from various causes: (1) An excessive quantity of solids in suspension. (2) Agents in the effluent liable to ferment or putrify and hence create a nuisance. (3) Coloring matters. (4) Substances liable to poison fish life, aquatic vegetation, or persons or stock using the stream for drinking purposes below the effluent. (5) Oily matters such as soap, fat, and grease.

Amongst the industries producing waste effluents containing large quantities of matter in suspension are tanning, cotton and woollen making industries and the paper making trade. Effluents from ammonia recovery plants, potteries, and bleach and dye works are also offenders in this respect. The waste liquids from breweries, distilleries, glue and beer root sugar fatcories, and from the tanneries and hide-dressing works contain highly fermentative and putrifactive constituents. Dye works, calico printing works and the like produce highly colored wastes. The number of trades discharging effluents injurious to organic life is very large, amongst them may be mentioned bleach or dye wastes, paper mills, ammonia recovery plants and many others. Soap factories, wool coloring works and laundries are the most frequent producers of oily, greasy and fatty wastes.

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*Paper read before the Regina Engineering Society.

Waste Effluents and Methods Adopted

It may not be out of place here to give a short sketch of some industries, giving a rough description of the processes involved in them, and a general idea of the methods adopted to counteract the action of such wastes before allowing them to pass finally into sewers or water courses.

Fell-mongering is an important trade carried on in connection with both the woollen and leather industries. The object of fell-mongering is to remove the wool or hair from hides and skins. The dried hides are first of all soaked for from four to seven days in water, they are then steeped in milk of lime and thoroughly brushed in a brushing machine to remove extraneous matters from the wool. After this hides, which may or may not be washed again to remove the milk of lime, are scraped, and the hair or wood sent to the wool conners while the skins are sent to the tanners. As might be expected the waste from the scouring and washing operations is of a very polluting nature containing lime, dirt and sand, and fragments of putrifying flesh. The washing process also produces a considerable quantity of solid matter in the form of sludge. This latter has a high manurial value and should be easily disposed of for that purpose. With regard to the wash and scour waters, these should be settled and screened before turning into a common sewer, the object of course, being to reduce as much as possible the solid matters in suspension, which might otherwise create a nuisance. The liquid element from fell-mongering works has been found to be amenable to the ordinary treatment given to domestic sewage on bacteria beds when mixed with it and discharged at a fairly moderate rate; but when it cannot be diluted with a much larger volume of sewage its bacteriological treatment may be facilitated by precipitation of the suspended solids with sulphate of lime.

After the hides pass into the hands of the tanner they are soaked in tanning solutions of various strengths, and finally pickled in salt, and put to dry and mature. The refuse liquid resultive from the tanning process, which is usually carried on in conjunction with the fell-mongering trade, is very foul and should be mixed with the effluents from the lime and soak pits mentioned previously and treated with them.

Woolscouring is a process through which the wool is put after leaving the fell-mongers. The wool is passed through a series of tanks, the first two containing hot soap solutions and the last clean water. The liquid run off from the first two tanks is very dirty and greasy; it is worth while to recover the grease. The process usually adopted in so doing is to first screen and settle the effluent thus removing the detritus and solid matter, and afterwards treat it with sulphuric acid to neutralize the alkali decomposing the soaps. The effluent is next passed through sedimentation tanks on the continuous flow system. These tanks are usually designed to hold about a quarter of the dry weather flow. The sludge is allowed to accumulate in the tanks and is afterwards discharged into vats where it is dosed with sulphuric acid and afterwards heated to boiling point of water by the application of steam. The sludge is then passed under compresesd air through filter presses which are kept hot by steam, and the grease flows off with the press liquor and is easily separated from it by skimming. After being cooled and purified the grease is barrelled and sold. Only twenty per cent. of the grease is removed by this process, but by distillation in retorts at a temperature of 600 degrees Fahrenheit the grease remaining in the sludge can be volatilised and afterwards condensed, leaving the residue in the form of a dry powder.

Bleaching is the first process through which cotton passes after being woven into calico. Its object being to remove the weavers size and other substances added to the cotton thread during the process of weaving. Before bleaching the cotton passes through two or three processes the last of which is boiling in large iron Kiers with caustic soda or lime. The cloth is then washed in clean water, soaked in a bleaching solution, and again washed. It is afterwards soaked in a weak solution of hydrocloric acid, thus dissolving any lime remaining in the weave and finally washed.

Dyeing is very often carried on in connection with bleachworks. The method usually adopted in dyeing is to pass the cloth through a hot solution of colour, analine dyes being used. After dyeing the cloth is washed in clean water.

Calico printing may be considered as a branch of the dyeing industry. The method most in use in this trade is to print the colors off on the cloth from engraved copper cylinders or rolls, the colors being made up in a paste with gum, starch, flour and other glutinous agents and applied to the rollers. Just before the cloth comes in contact with the rollers all the color, except that adhering to the engraved portion of the cylinders is stripped off so that only the engraved portion is left in colour on the cloth. After printing the cloth is passed through a hot soap solution and then washed.

As can be readily realized a great variety of objectionable matter is contained in the waste from these trades. Amongst them are starch, lime, grease, soluble soaps, salts, of lime and soda, dyes, etc. As the three trades are usually carried on together it is in most cases possible to mix the effluents from them all at the same time. The suspended solids are easily precipitated by the use of lime or alumino-ferric, and by passage through continuous flow precipitation tanks a measurably clear effluent may be obtained. The remaining impurities can be removed by filtration, even the coloring matter being usually removable in this way due to the mechanical effect if coagulation and the straining action of the filter.

The treatment required for paper mill effluents varies somewhat with the class of paper manufactured. For the highest class papers having a highly finished surface, espanto grass is used. The grass is boiled for several hours in kiers with a solution of caustic soda, when the liquor is run off and the grass washed in clean water. It is then broken up in "potchers" and bleached, and again washed. After the addition of china clay it passes into the paper making machine, on an endless band of copper gauze, going through rollers which squeeze out most of the moisture, and then passing over many steam heated cylinders, till at length it is wound on the final drum as paper. The liquor run off from the kiers is usually mixed with the water from the first washing and evaporated to recover the soda, the second wash water is mixed with the other waste waters and settled out in shallow lagoons.

In the manufacture of writing papers dyes are used. The processes involved are similar to those for espanto grass papers, but the kier liquors are not so strong, and instead of being evaporated the first run-off is run into a lagoon and settled separately from the other liquids but in the same manner.

Brown papers are made from peat, old sacking, tarpaniline, rope, etc., and from the dirty nature of the materials used strongly polluting liquids arise. They are usually settled and filtered in the same way as previously mentioned.

In making newspaper wood pulp is used. In making this paper the caustic soda treatment in the kiers is seldom needed. Ordinary settlement of the waste liquids is usually sufficient. The sludge from this process is, however, rather valuable, and if pressed can be readily disposed of for making into colored paper.

All paper making effluents are exceedingly alkaline and very injurious to fish life. This is owing to the large amount of caustic soda used in the process of manufacture. The suspended solids should in all cases be removed by precipitation with sulphate of lime and iron, and the clarified tank effluent passed through suitable filters before being turned into a stream, lake or sewer.

In the brewing industry the chief source of pollution in the waste arises from the wash waters used in cleaning barrels, fermenting tanks, and cooling vats. The waste contains considerable quantities of suspended matter in the shape of spent hops, grains, yeast, etc., and decomposes rapidly, producing lactic and butyric acids. It has a high temperature and a tendency to sour rapidly thus rendering it difficult to treat bacterially on filter beds. It can, however, be successfully treated by first precipitating the suspended solids with lime neutralized with copperas and afterwards turning onto percolating filter beds. Where a brewery effluent can be turned into ordinary domestic sewers its treatment is greatly simplified as the anaerobic bacteria in the sewer counteract the tendency of the waste to turn sour, but the vital point in connection with the treatment of this waste is to deal with it before it becomes an acid liquor.

Having sketched these few industries and given a more or less rough idea of the methods that may be employed in purifying the effluents arising from them, it will be now advisable to state a few general principles guiding the treatment of trade effluents in general.

Trades waste containing lime, calcium sulphide and sulphate (the effluents from ammonia recovering plants, gas retorts, and coke ovens, contain these constituents), magnetic oxide of iron (from analine stills) occulent and fibrous matters, etc., can in most cases be clarified by simple settlement in suitably constructed tanks, in certain cases mechanical filters or fine screens may be used. Fermentative and putrefactive effluents may be treated biologically in tanks and filters, but starching wastes are sensitive to anaerobic treatment and are more easily dealt with when mixed with ordinary domestic sewage. Industrial effluents containing coloring matters of vegetable origin, and belonging to the "aniline" variety which are alizarene derivatives may be precipitated by means of iron or aluminium salts, other colouring matters may be destroyed in biological filters when mixed with sewage. Apart from their color they are innocuous. Alkaline sulphides in effluents may be treated with an excess of lime or a mixture of lime and ferrous sulphate (copperas), but the precipitated sulphide must be settled out in tanks before the effluent is finally discharged to prevent the evolution of sulphuretted hydrogen which might arise if the liquor came in contact with free acid.

It is important that all acids and alkalis unless present in very limited quantities should be neutralized before their final discharge. Chlorine in small amounts in either its free state or as hypochlorite is not likely to cause much trouble in sewers, but should not be allowed to pass into streams or lakes except in merely nominal quantities. Sulphuric acids of benzent and napthalene are open to ordinary treatment at sewage purification works when sufficiently diluted and mixed with domestic sewage, but are very injurious to the microscopic life in fresh water. The same remarks apply to effluents containing sulpho-cyanates, thio-sulphates and sulphides. Free particles of grease present in a trades waste should be trapped before the final discharge of the effluent into either sewers or streams. Soaps can be broken up by acids and separated and purified, or simply precipitated with lime.

The importance of the adequate treatment of trades waste can be realized from even so cursory an outline of the subject. There can be no doubt as to its necessity. Local Government Boards, local and public health authorities, and others having jurisdiction over foreshores, lakes and streams, and common sewers would seem to have a clearly defined duty confronting them in the making of regulations governing the discharge of trades waste effluents in the different spheres of their authority. Manufacturers are in business for profits, and unless they can see material benefit accruing to themselves by so doing, are extremely unlikely to spend money on treating the wastes from their industry. The advantage, therefore, to the community of regulations defining the degree of purity required in trade effluents can scarcely be over-estimated. Even the manufacturer himself, is usually benefitted by them as they preclude to a great extent, when properly complied with, risks of loss to him by litigation consequent upon his works, which might arise were such regulations not in force.

In the absence of such regulations the duty of the engineer is somewhat difficult. It is when called upon to design a sewerage scheme for an industrial plant to so lay out his scheme that the least possible nuisance may arise from the final effluent. It is, however, asking rather much of the engineer, employed by a manufacturer and in his interests, to do this in cases where statutory obligations may favor a cheaper but not so efficient design from the point of view of the purity of the final effluent. The conscientious engineer finds himself at a discount in such circumstances. The story of the cameleon may be familiar. The cameleon was placed on cloths of different colors and changed color quite successfully on each. Finaly he was laid on a piece of tartan. He wept salt tears and expired. In the words of the original teller of the story "He done his best but he busted." The engineer cannot be expected to serve two interests any more than could the victim of this story.

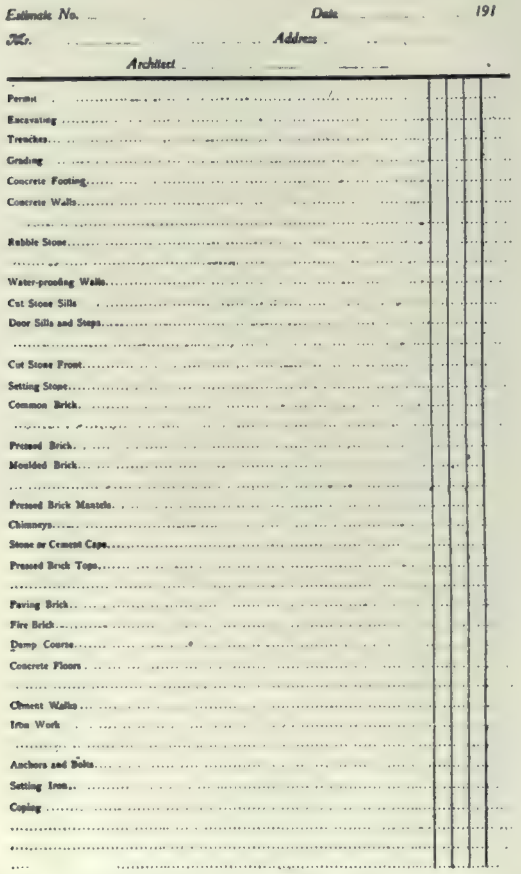
According to a despatch from Quebec, the City Council will seek power to purchase the Dorchester Electric Company at a cost of one million dollars. This is a steam plant, and supplies current for the electric lighting of the city.

Methods Which Make for Profit or Loss in Estimating

THERE are two stumbling blocks to the success of the average contractor, said a well-known builder of big buildings, recently, and many men are not aware of them. I allude to the estimator and the foreman.

If you will analyze a percentage of the failures of men in the contracting business you will find that about three-quarters of them are brought about by leaks, little or big, in the estimating department. The others can usually be traced directly to inefficient foremen.

This is a broad statement yet it is one that has a great deal of truth in it. In addition to the two stumbling blocks mentioned above another might be mentioned—the boss, himself, who through lack of personal supervision makes it possible for estimators to make costly mistakes and get away with them.



Estimate No. Date 191
Mr. Address
Architect

Permit
Excavating
Trenches
Grading
Concrete Footing
Concrete Walls
Rubble Stone
Water-proofing Walls
Cut Stone Sills
Door Sills and Steps
Cut Stone Front
Setting Stone
Common Brick
Pressed Brick
Moulded Brick
Pressed Brick Mantels
Chimneys
Stone or Cement Caps
Pressed Brick Tops
Paving Brick
Fire Brick
Damp Course
Concrete Floors
Cement Walks
Iron Work
Anchors and Bolts
Setting Iron
Coping

Fig. 1—Estimating blank used by a successful contractor for many years.

This estimating proposition is the weak spot in many other kinds of business as well as contracting. Take the average store keeper who runs behind until he really goes under, and you will find the main reason for his failure isn't so much lack of trade as it is loss of profit owing to carelessness in computing the difference between what goods cost and what they should be sold for; in other words he is a poor estimator.

Here is about the way the thing works. A man decides to go into the retail store business. He casts about for a location with the idea of starting in new with a fresh line of goods, or else, perhaps, he decides to buy someone out. After the location is secured he stocks up, unlocks the front door and awaits trade. Now the first thing any merchant ought to do is to figure out the exact cost of his goods, plus freight, plus rent, plus heat and light. To this he should add the depreciation on any stock not quickly sold and a percentage on goods slow to move. Once having the exact total cost of his goods it would seem easy to add the percentage of profit and establish a correct selling price. Many merchants make errors in their computations, however, and after they have been in business a while they are astonished to find that they are making no profit. Indeed, many discover when it is too late, that goods have been sold below cost and customers are getting the benefit of careless business methods.

Before any contractor can estimate intelligently he must first know the exact cost of his goods. Right here is the weakness in a good many offices. Cost prices are frequently made up from lists prepared a few years ago before wages and cost of materials went skyward. Or, often, contractors carelessly add to a former cost list the approximate percentage of increase; a computation that is frequently in error and set altogether too low.

Contractors themselves do not agree upon the best way to go at the estimating proposition. Many contractors, and successful ones, too, instead of figuring the net cost of work and then adding percentage of profit, simply figure every item, gross (cost plus profit); the total of all items added forming the sum of the complete bid.

Other contractors maintain that the only correct way is to take the net cost of each item, add these together and then add the percentage of profit. There are advantages to each system and no doubt exponents of each system will continue to do it their own particular way.

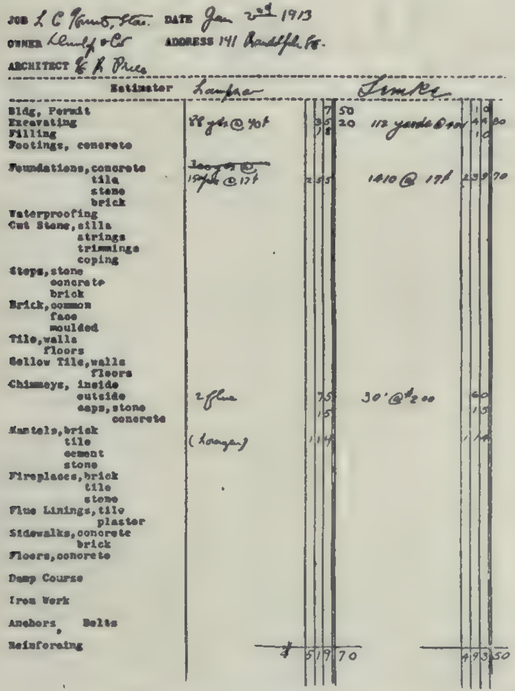
One advantage of the first mentioned method (gross cost system, including profit) is that it is a little less work to make such a bid. If brick-work is figured at, say $16.00 per thousand (which price includes price and profit) the total amount of the bid may be computed a little more quickly than when brick is figured at a net cost of, say $12 per thousand to which the contractor adds a profit of $4. Another advantage of this system lies in the fact that since many contractors have made bids for years based on gross costs, to begin making bids on a net cost system would involve rearranging their schedule of prices—quite a difficult job, of course.

One of the simplest estimate blanks I have seen is illustrated in Fig. 1. The contractor (who got it up for his own use) employs the gross cost method. When making a bid his estimator goes through plans and specifications, carefully computing the cost of each item.

These costs are based upon prices which his experience has taught are sufficiently high to pay the cost and yield him the percentage of profit he requires. Every item is filled out in the blank, and from the total figure resulting the contractor makes up his bid. The blank, being retained in the contractor's files for future reference, is not sent to the architect or owner. When the building is completed the estimator can compare the actual cost of the job with the estimated cost.

Right here let it be said that the estimator, himself, is one of the most important units in the contractor's machine for frequently the skill, prestige and capital of the contractor is discounted by the carelessness of an estimator whose low bid makes it impossible for the contractor to make any profit. On the other hand many a contractor has built up a good, profitable business by means of the accuracy and skill of his estimating department.

The prevailing weakness, inaccuracy, seems to be possible in any office, large or small. Now and then it is unpleasantly brought to the attention of the contractor who is suddenly shocked to find he has lost more money on one job than he can make up in half-a-dozen others. "Many contractors are dubs," said the general manager of a large concern to me, recently. "They deserve to lose. On our new factory contractors lost a hundred thousand dollars. Yesterday a friend of mine told me that a firm of contractors he employs lost heavily on three jobs they are just completing. Usually losses of this character are inexcusable, occurring most frequently on account of the indifference of contractors who are not sharp enough to check their estimators."



JOB L C Yount, Stor. DATE Jan 2nd 1913
OWNER Lundy & Co ADDRESS 141 Randolph St.
ARCHITECT E R Price

Estimator	Lampra		Limke	
Bldg, Permit		7 50		10
Excavating	88 yds @ 40¢	35 20	112 yards @ 40¢	44 80
Filling		15		10
Footings, concrete				
Foundations, concrete	~~[illegible]~~			
tile	1410 @ 17¢	255	1410 @ 17¢	239 70
stone				
brick				
Waterproofing				
Cut Stone, sills				
strings				
trimmings				
coping				
Steps, stone				
concrete				
brick				
Brick, common				
face				
moulded				
Tile, walls				
floors				
Hollow Tile, walls				
floors				
Chimneys, inside				
outside	2 flue	75	30' @ $2.00	60
caps, stone		15		15
concrete				
Mantels, brick	(lounges)	114		114
tile				
cement				
stone				
Fireplaces, brick				
tile				
stone				
Flue Linings, tile				
plaster				
Sidewalks, concrete				
brick				
Floors, concrete				
Damp Course				
Iron Work				
Anchors, Bolts				
Reinforcing				
		$519 70		493 50

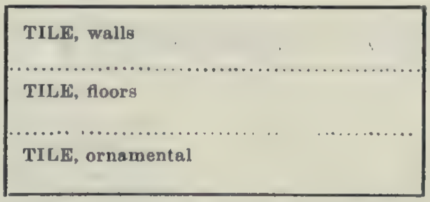
Fig. 2—Two estimators compare this blank, one checking the other.

"In our business," went on the general manager, "we can tell to the fraction of a cent what every article costs. We know the exact overhead charge for the entire plant including cost of buildings, machinery, insurance, depreciation, wages of heads of departments—in fact," he said emphatically, "it would be impossible for us to lose money on any of our merchandise unless we deliberately and knowingly decided to sell it below cost."

"When contractors are willing to work out cost sheets in the same accurate way there will be fewer failures in the contracting business. There should not be guess work in figuring the cost of a building any more than there is in estimating the cost of merchandise. Every contractor who has an efficient working organization should be able to work a system of costs that would prove mistake-proof."

As a matter of fact the contractor is up against a harder game in figuring costs than the manufacturer. You can compute how much work a machine will turn out but you cannot tell to a dollar how much work mechanics will produce, depending (as the computation will) upon weather, labor troubles, crankiness of architects or owner and numerous other noncontrollable conditions. Nevertheless, the careful estimator with complete cost lists should hit the result more accurately than is frequently the case.

Fig. 2 shows a new estimating blank called a "check system blank." The idea in using this form is to have two estimators figure on the same job, one checking the other. The first estimator fills out the items in the usual way after which he folds over the edge of the form to cover his figures. Then estimator No. 2 makes his own calculations without reference to the first list, after which he compares the two results. Any glaring discrepancies are instantly noticeable and such items should be computed again.

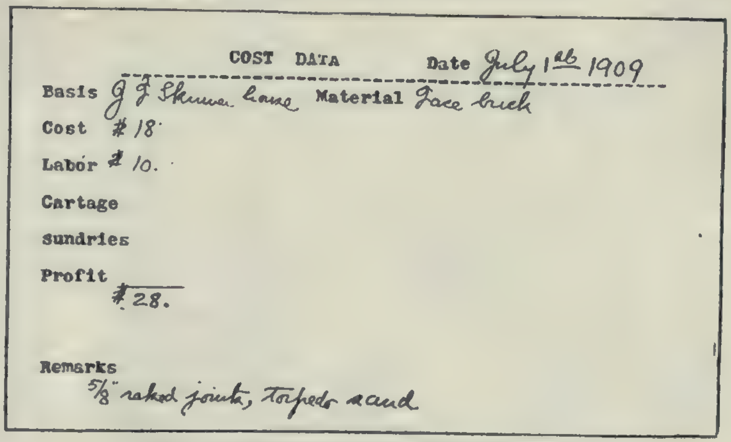


TILE, walls

TILE, floors

TILE, ornamental

Fig. 3—Perforated gummed sheets for pasting in estimate book.



COST DATA Date July 1st 1909
Basis G J Skinner loans Material Face brick
Cost $18
Labor $10.
Cartage
Sundries
Profit
$28.
Remarks
5/8" raked joints, torpedo sand

Fig. 4—Loose leaf index card for tabulating costs.

The advantage of having a printed form for making out estimates is obvious. When contractors merely compute estimates in a blank book kept for the purpose they are liable to forget one or more items. With printed form covering every operation such items are less liable to be forgotten.

Another new idea recently advanced is to print the estimating blank on gummed and perforated paper. In making out an estimate, it is proposed to tear off from this sheet the items required in the estimate, pasting them in the estimate book (Fig. 3). For instance if the job is a small one containing only such items as "permit, excavating, stonework and brickwork," the corresponding headings would be filled out on the estimating blank, torn from the perforated sheet and pasted into the estimate book. Thus, reference to a sheet in the first place would act as a check against admitting any items, but there would be no long list of items left blank since only the items needed would be pasted in the book.

For keeping cost lists there are several methods open. A book can be used for this purpose, indexed for quick reference. On page set out for cost of brickwork, for instance, one can enter cost of common brick, cost of face brick, cost of wide joints, raked joints, and so on. Another good way is to employ a card index system of costs (Fig. 4). Cards are particularly desirable for new ones can be substituted as fast as prices change.

In filling out cost cards it is a good idea to have "material" and "labor" entered separately. In this way any fluctuation in labor or material can be readily altered on the card. As prices go up or down a record can be made so that when any estimating is done the estimator will have late prices to quote from.

No part of the contractor's equipment is more important than these cost sheets. They should be filed in a drawer or cabinet where they can be instantly referred to. It is an excellent idea to keep them under lock and key as more than one contractor has found out. Unscrupulous estimators, in a huff after being discharged, have been known to "go over to the enemy" with a complete copy of their former boss's cost lists; of immense advantage to a competitor.

It is surprising how indifferent to the importance of accurate estimating some contractors are. In one office I have known estimates to be made out by the office boy, who has been with the firm several months to be sure, but is hardly a good hand to "take off" quantities accurately. In other offices it seems to be the practice to shove laborious estimating off on the stenographer. Really, this job of estimating is important enough to be done by the boss himself. At least, if not done by him it should be attempted only by an expert, for no branch of the contracting business is more important nor in any office, large or small, immune from loss and eventual failure if the estimating department is not turning out accurate work.

Developments in Pumping Machinery

Contributed by Wm. Perry

IN the year 1641 a mechanic in Florence received an order to make for the Grand Duke a pump with a suction pipe extending between 50 and 60 feet between the valve and the level of the water. The pump was made and placed, but of course, when it was worked it raised no water. In the belief that the fact was due to some defect in the construction the maker was told to take it to pieces. This was done repeatedly, and new attempts were made to get the pump to perform the duty required. When nothing more could be done in this way the superintendent of the Grand Duke's water-works consulted Galileo, then eighty years old, blind and within a few weeks of death. The philosopher had never seen reason to doubt the truth of the opinion universally prevalent at the time that Nature "abhors a vacuum"; it was universally held that the power which raises water in pumps is some occult force, which, resisting all attempts to form a void, instantly presses water up the pipes when the air previously in them has been exhausted by the piston. When the whole circumstances of the difficulty at Florence were placed before Galileo he could only reply that Nature's abhorrence of a vacuum is limited and ceases to operate above the height of 33 feet. This opinion, given without opportunity for due examination, was probably not quite satisfactory to Galileo at the time. Within two years Torricelli, who lived with his family and assisted Galileo during the last three months of his life, was able to announce that this "occult force" was the pressure caused by the weight of the atmosphere.

This important fact he first established by an experiment as simple as it was ingenious and conclusive. He had made a model of the Grand Duke's pump, which had a suction pipe sixty feet long placed perpendicularly, with its lower end in the water. When the air at the top was exhausted, Torricelli found that he could by no means make the water rise more than 32 or 33 feet. He reduced the pipe to 40 feet, but without better success. It then occurred to the experimenter that if it were indeed the weight of the atmosphere which sustained the water in the pipe a substance other than water would rise to a height in the pipe exactly in proportion to the relative specific gravity of water and of the other substances employed. But a short time elapsed before this thought was submitted to the test of an experiment.

The medium employed was quicksilver, which is about 14 times heavier than water. When a vacuum was produced in the top of a tube, the lower part of which was filled with quicksilver open to the pressure of the atmosphere, it was at once seen that the column was supported at a height of only one-fourteenth that of the column of water. Quite a number of experiments have been made since. These have not shown any better results than those obtained by Torricelli.

I have had quite a wide experience in pumping machinery, going into the pump shop in 1851, and am the oldest pump expert in the Dominion today, and the best I ever did was at Chatham, N.B. When I had a vacuum of 27 inches I started the pump (a new one) and drew down to 30 feet, but I could not lift the water after stopping until the water raised in the well, 27 in. vacuum equals 30.62 feet.

Water is propelled through the suction pipe of a pump by the act of removing or lessening the pressure of the atmosphere on the surface of the water in the suction pipe. Properly speaking there is nothing in the operation resembling that of suction, one end of the pipe being placed in the water and the other end connected with the pump inlet, which is closed by a valve or valves. The stroke of the pump piston or plunger has the effect of partially removing the air in the pipe. The surface of the water being then relieved of a portion of the atmospheric pressure, there is less resistance offered to the water rising in the pipe. The water inside the suction pipe rises above the level of that outside in proportion to the extent to which the pressure of air is removed. If, for instance, the pressure of air within the suction is reduced by the first stroke from 14½ lbs. to 13½ lbs., the water will be forced up the pipe about 2¼ feet, because a column of water an inch square and 2¼ feet high is about equal to one pound in weight.

Upon the reduction of the pressure of the air contained in the suction from 14½ lbs. to 13½ lbs. per square inch, it is evident that unless the water ascended the pipe there would be an unequal pressure upon its surface inside and its surface outside the pipe. In consequence of the water rising 2¼ feet in the pipe the pressure upon the surface of the water, both inside and outside, is evenly balanced, as the pressure upon the water exposed to the full atmosphere is 14½ lbs. upon each square inch of its surface, while that upon the same planes, but within the pipe, will sustain a column of water 2¼ feet high (weighing 1 lb.) and 13½ lbs. pressure of air, making a total of 14½ lbs. If in consequence of a second stroke of the piston or plunger the air pressure in the pipe is reduced to 12½ lbs. per inch, water will rise another 2¼ feet. This rule is uniform.

The following table gives the velocity of flow through a suction pipe in feet per second with various heights—barometer 30, thermometer 60 deg. Fahr.

Height of pump in feet	Velocity of flow in pump chamber	Height of pump in feet	Velocity of flow in pump chamber
1	46.16	18	32.21
2	45.45	19	31.19
3	44.75	20	30.14
4	44.01	21	29.06
5	43.23	22	27.93
6	42.33	23	26.75
7	41.77	24	25.52
8	40.90	25	24.23
9	40.20	26	22.80
10	39.39	27	21.41
11	38.57	28	19.85
12	37.72	29	18.16
13	36.86	30	16.29
14	35.98	31	14.18
15	35.07	32	11.70
16	34.14	33	8.52
17	33.19	34	2.89

It will be seen that a pump will not raise with a velocity which is of practical value at a greater depth than 22 to 24 feet, and this is about the extreme limit of a pump's efficiency. Such heavy duty as this cannot be done except under the most favorable conditions. There is, however, hardly any limit to the length of horizontal suction pipe through which a pump will draw, provided both the pump and the joints are air-tight and the sizes are so proportioned as not to cause undue friction. I have put in a suction pipe 3,000 feet long, 16 ins. diameter, cast iron lead joints, and tested to 150 pounds pressure before covering in and another 750 feet long, 20 foot lift. What is most essential in a suction pipe is a vacuum chamber and where to place it. As a rule, pump manufacturers take too much for granted. They usually think that any one who purchases a steam pump understands how to connect it up properly. It is quite surprising, however, to find how few really know how to connect up a steam pump to get the best results, especially where the supply comes under a head. I usually take the trouble to follow up each case and see what the purchaser intends to do with the pump in the matter of piping and location and connections.

Regarding the use of suction chambers, I consider them of great importance when rightly placed on the suction pipe. I have what is called a Fire Engine used at the big fire in London, England, in 1666, and 12 copper plate engravings of fire engines invented by two brothers in Holland in 1630. The principle in connection with the inlet and outlet valves has not changed from that day to this and the copper plate engravings are not surpassed in any catalogue today. They did not have hose or suction pipes, but they did good work, which is shown on the different engravings.

Protection of Unfinished Concrete

THE use of concrete during the winter months has always been attended with more or less danger, and opinions are divided as to the advisability of placing concrete in freezing weather. Mr. Leonard C. Wason, president of the Aberthaw Construction Company of Boston, Mass., in a recent paper read before the Boston Society of Civil Engineers, gives a number of interesting items which he has found during his experience in that line. It seems to be generally considered that the concrete laid in the winter months will be exactly as good as that in the summer, and possibly more so, if the necessary precautions to protect it are taken.

The aggregates must be free from fost when mixed. A live steam pipe should be shoved into the sand pile, the escaping steam heating it and removing all frost. The same may be done with the stone, but a canvas should be thrown over the top of the pile to retain the heat, which more readily escapes. When a considerable amount of heating is provided for in advance, steam pipes are laid on the ground, and stone as received is dumped upon them. Then there is a canvas thrown over to prevent storms getting into the pile and to retain the heat. The frost is thus easily and economically removed.

Salt is frequently used in the water to lower its freezing point. It is seldom worth while to heat the water itself. Little care need be used to prevent mass concrete from freezing, as the frost will usually only strike to a depth of about one inch. Buildings are inclosed with tarpaulin tied onto an outside staging, and the inclosed space is heated with salamanders burning coke. Sometimes it is possible to use steam.

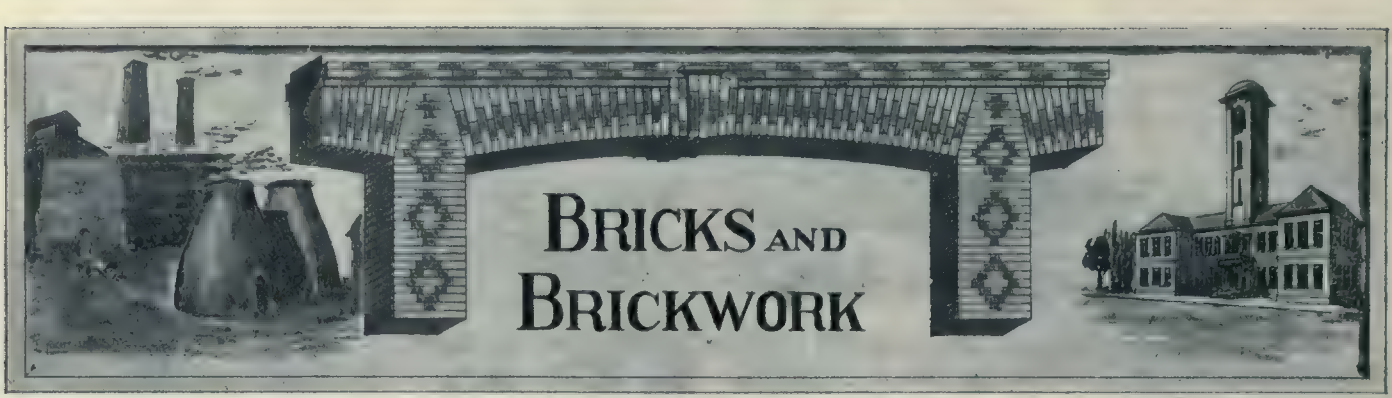
Frost is removed from work by the use of salt and steam, and if the concrete surface is left rough it is common to sprinkle the top surface with salt to prevent freezing. In winter it is very common to put the finish on as a separate operation, after the building is enclosed, and not as an integral part of the construction, on account of the danger of freezing. After it is put on, it must be kept from freezing for the first forty-eight hours.

The expense of protection against the weather is not very great, and good results can be so surely guaranteed that it is not usual to discontinue work on account of cold weather.

Occasionally it is necessary to make some provision for the protection of the men. Shelters or wind shields are built in front of the benches where carpenters are making up forms, as well are around the men at the concrete mixer, whose work does not necessarily keep them warm. Where excavation is going on in the open, it is expedient to have a building with a good fire, where the men can warm themselves when necessary; and on a few jobs it has proved to be wise to provide hot coffe free in these shelters.

The greatest iron-ore producer in the United States is Minnesota, by a wide margin, according to a bulletin issued by the U. S. Geological Survey. In 1913 the total marketed production in the country was 59,643,098 long tons, valued at $130,905,558, of which Minnesota contributed 36 603,331 tons, valued at $80,789,025. In 1912 Minnesota produced 34,249,813 tons, valued at $61,805,017.

In pursuance of the policy of double tracking the principal lines, the C. P. R. are constructing a new double track bridge over the Lachine Canal, P. Q.



BRICKS AND BRICKWORK

The Possibilities of Brick in an Educational Exhibit

THE possibilities of brick are well illustrated in the accompanying views of brick exhibit rooms. As a matter of fact, no illustration can do justice to the great variety of rich, soft color tones here displayed in buffs, greys and reds, finished in rough and smooth textures and enamel. Adequate color reproduction is unsatisfactory and the black and white print is the best available. But even at that, the photographs are sufficiently illuminating as to the possibilities of brick in the work of educating the public to the best use of constructional materials.

Such exhibit rooms as these, and that of the Don Valley Brick Company, Toronto (which we hope to illustrate in a later issue), suggest that manufacturers are awakening to the advantages of putting material proof behind their selling arguments. With no other single material of construction can such artistic effects be produced. A brick wall built up of many units, each carefully laid in place, expresses individuality and character impossible to obtain with any other building material. This is axiomatic: even the cement man will admit that it is beyond dispute. It has been said that the brick wall is to the cement surface or a painted wooden surface as an Oriental rug is to a single colored carpet or as an oil painting is to a chromo. During the last few years so many excellent uses have been found for cement and so many advantages have been discovered for it, particularly in all forms of engineering work, that there has been a popular tendency to side-track the oldest and most honorable material of them all.

Professor Gillespie, of the University of Toronto, is well known as an expert on cement and concrete, but his attitude towards brick is proved by the opening paragraph of an article entitled, "Brick Masonry in the Light of Recent Tests," which he contributed a few years ago to one of the special numbers of this journal. Therein he wrote:

"Begun in prehistoric days, when primitive man fashioned the clay and baked it in the sun; developed and improved with the accumulated experience of succeeding ages and perfected in recent times through the investigations of the ceramist and the chemist, the brick-maker's art commands a respect and possesses a prestige analogous to that which attaches to an old and honorable family."

Brick has withstood the ravages of time for thousands of years. Brick walls built by the Babylonians three thousand years before Christ are still standing in good condition, while others built of competitive material, erected only half the time, have crumbled to dust. Brick has been known and recognized in every age. From the sun-dried clay of the early Babylonians down to the latest product of the best of our Canadian and American factories, the two outstanding characteristics of the material that have never been disputed have been Permanency and Variety.

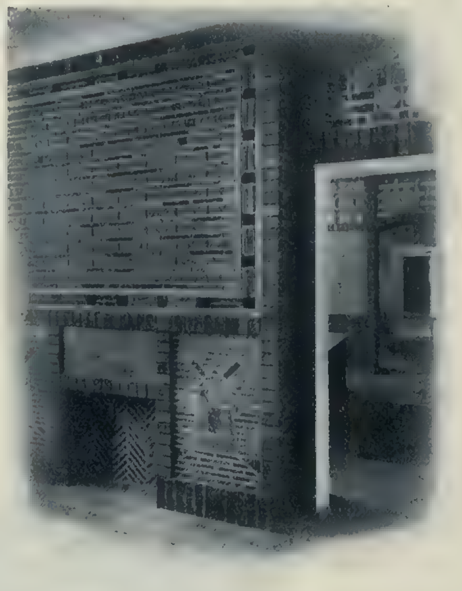
Brick improves with age and its value does not deteriorate. The Hy-tex people quote a case in point: "In a large mid-Western city are two houses side by side, built at the same time some years ago by two brothers. Both are of simple and rather commonplace architectural design. The more substantial and dignified appearance of the brick house seems due to the brick alone; the main difference in the floor plans and designs is that the frame house is larger. The first cost of the brick house was slightly greater, but—the frame house was sold recently,—and it was no forced sale either—at a loss of 40 per cent. of its original cost; while for the brick house, standing on the next adjoining lot, recent bidders have offered twice its original cost."

A point that may well be impressed upon all users of constructional material is that first cost is only one of the many elements that enter into genuine economy. In the construction of a residence it may be possible to effect a saving of several hundred dollars by substituting cheaper material for brick, but the principal and interest on the additional amount are soon made up. An interesting illustration of the place occupied by brick in comparative costs is contained in the booklet "Genuine Economy in Home Building" (Hydraulic-Press Brick Company). In this booklet attention is directed to a view of a residence completed recently at St. Louis. This house has 13-in. solid brick walls and is faced all around with Hy-tex brick. We extract the following from the booklet:

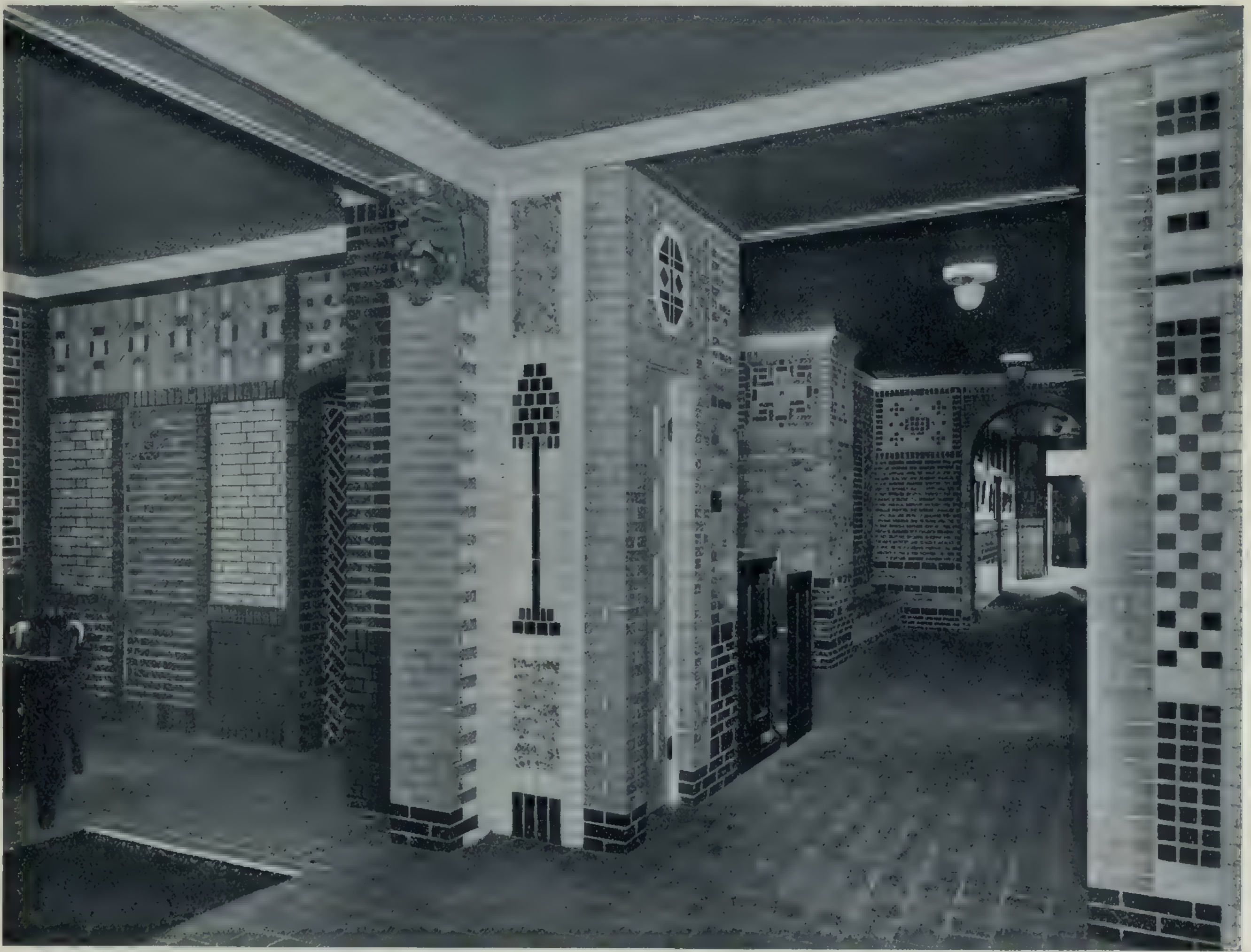
"This house is built very substantially, with tile roof, copper gutters, cut stone sills and trim. All the details are such as a purse-free home-builder desires. To build the house complete cost $9,875. We have on file the itemized price-sheets and contract bids.

"To obtain definite, unprejudiced, up-to-date figures on comparative costs, we had the blue-print plans of the house re-figured by one of the most careful contractors in St. Louis, as if the outside walls were to be of frame instead of brick. Our frame specifications assumed that all other items except outside walls remained the same. We were not content with the **estimated** price; we secured a **contract bid** for which the contractor could be held to take the job. The contract price of brickwork, both material and labor, on

The views reproduced herewith are of the exhibit rooms of the Hydraulic-Press Brick Company at St. Louis. On the left is shown a glimpse of a corridor; on the right a Dutch fireplace; and below, the main hallway and piers. The great variety of rich, soft color-tones here displayed in buffs, grays and reds finished in rough and smooth texture and enamel, make adequate color reproduction unsatisfactory.



THE POSSIBILITIES OF BRICK



this house as actually charged was $1,465. The contractor's bid for frame construction on the same house was $1,137.71, a difference of $327.29. To this, in all fairness, should be added the cost of the cut stone used in the brick house for window sills, around the porch, and for trim, $102, increasing the total difference in favor of frame to $429.29.

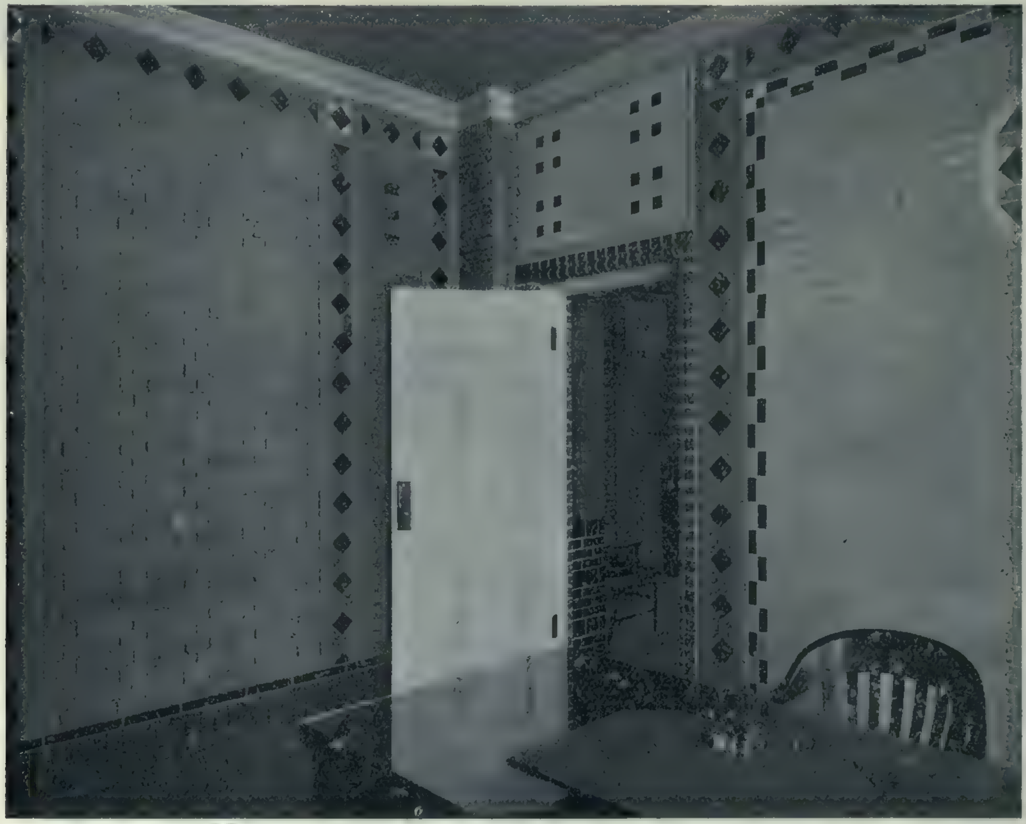
"Then we sent photographs and blue-print plans of the same home to our office managers in Philadelphia, Cleveland, Indianapolis, Omaha and Minneapolis. They in turn secured from prominent residence contractors in their cities actual bids, not estimates, for solid brick and for frame outer walls, just as we had done in St. Louis. These cities are fair representatives of building costs, both in material and labor, for the nation, and the results obtained are of timely value to every prospective home-builder.

"Next to the St. Louis figures, Indianapolis showed the lowest difference in favor of frame, with $610.19. Omaha followed close, with the brick walls more expensive by $671.27. Philadelphia and Cleveland were next in order with $755.02 and $771.70 respectively. In Minneapolis, whose early fortunes were built on timber, the difference in favor of frame was $855. For these six representative cities, the average difference in first cost between brick and frame construction was $682.08.

"Thus we see that even where frame is cheaper the saving effected by its use is only 8.6 per cent. of the cost of brick. Where the difference is least, brick cost only 4.4 per cent. more. The average difference in the contract bids of the six cities was 6.9 per cent.

"While we also called for contract bids from several cities on other forms of construction, we will not take space to quote them here. These other forms, such as stucco or cement siding, brick veneer, either on frame or on hollow tile, and 9-inch brick walls, all lie between the two extremes which we have itemized. Reinforced concrete and natural stone are both considerably more costly than the most expensive form of brick construction."

In conclusion, one can only point again to the admirable work which we have attempted to illustrate in these pages as a proof of what can be done and what is being done with brick. More of this kind of work is necessary. If brick manufacturers put more life into their trade and exert themselves more in the way of providing additional facilities for the public they will reap a richer harvest than they have done. Brick, of all materials, lends itself to skilful use and arrangement in the exhibit room. Let us hope, then, that such facilities will be increased and improved upon until it becomes a matter of pleasure and education to call in and see the brick manufacturer.



The Gray Room in the offices of the Hydraulic-Press Brick Company.

The largest chain-drive transmission in the world is said to be that of the Ox-Bow hydro-electric plant on the Snake River at Copperfield, Ore. The installation consists of one 3,600 kw., three-phase, 60-cycle generator, running at 225 r.p.m., operated by two water-wheel units. Each of these units consists of two pairs of water wheels of the horizontal type, with 48-in. centre discharge, set in open flume, and operating at 21 ft. head and 147 r.p.m. The water is supplied through a tunnel cutting off a bend in the river. Each water-wheel unit is connected to the generator by four Morse chains 21 ins. wide, with sprockets of 2-in. pitch on the line shafting, and with shaft centres 10 ft. apart. The generator shaft is in the centre and 5 ft. above the level of the water-wheel shafts. This chain drive is said to be three times greater in size than any previously built, the largest one previous to this being at Indianapolis, Ind., and driving a 1,200 h.p. generator. The Ox-Bow plant was designed originally to operate under a 45-ft. head obtained by a natural fall of 21 ft. by the tunnel through the bend in Snake River, and the building of a diversion dam across the river below the tunnel. Both the water-power and electrical machinery were purchased for this head, but due to financial troubles the company was unable to build the dam and for four years the property lay idle. The plant was put in operation on September 30. It was designed by the W. H. Rosecrans Engineering Company, of Chicago.

A Discussion of Building-Factor Costs

By Harold L. Green, in the Engineering Magazine

"No one at the present time can say what is a standard buildings factor proper to a machine shop, a foundry, or a rolling mill, and this implies that no one is in a position to say that this or that particular instance is an example of efficiency when it is discovered." This interesting statement appears in a well known book on cost accounting.*

It has been my privilege to develop burden charges in several large industrial plants during the last two years. The development of a buildings-factor, which should include all the expenses attendant upon the ownership, use, and occupancy of a building, and which should be expressed in terms of an annual charge per square foot of floor space in the building, was a necessary part of this work.

Although an explanation of how these buildings-factor costs were determined and what the costs were found to be in several industries would not set up absolute standards of efficiency, such data would enable relative comparisons to be made, and would serve as a basis for studying the elements of buildings-factor costs with the object in view of approaching a maximum efficiency.

Therefore it is the purpose of this article to state the elements of the buildings-factor costs as determined by the writer; to describe how the costs were obtained; to state the average cost of these elements as found in a large number of specific cases; and to draw brief conclusions, based on the above results, as to how an efficient land-and-buildings factor may be attained.

There is no fixed set of elements making up a land-and-buildings factor. In the majority of cases, however, the elements discussed in this article will include all the costs making up a complete factor for the purpose of a square-foot distribution to departments or production centres as the cost-accounting practice may require. Thus the elements which have been selected are almost universal, while those particular to special industries are not considered. Following is a classification of these elements together with an explanation of how the cost of each was determined: 1. Fixed charges on land; 2. Fixed charges on buildings; 3. Fixed charges on buildings fixtures; 4. Power and light; 5. Heat; 6. Building expense.

Fixed charges consist of interest, taxes, insurance, depreciation, and repairs, and are calculated as a percentage of the appraisal value of the land, buildings, and fixtures. The interest rate was taken at 5 per cent. in all cases. Tax and insurance rates were determined for each particular case. These rates were quite uniform, however, and 1 per cent. for taxes and ½ of 1 per cent. for insurance would be fair averages. On buildings the rates for depreciation and repairs averaged 2 per cent. and 3 per cent. respectively, while for buildings fixtures, which consist of steam and water piping, electric-light wiring, elevators, sprinkler systems, etc., rates of 5 per cent. for depreciation and 5 per cent. for repairs were used.

For convenience these rates are summarized in the following table:

	Land. per cent.	Buildings. per cent.	Fixtures. per cent.
Interest	5	5	5
Taxes	1	1	1
Insurance		.5	.5
Depreciation		2	5
Repairs		3	5
Total	6	11.5	16.5

It is evident that correct interest, tax, and insurance rates can be determined. Correct reserves for depreciation and repairs are open to considerable discussion, however, and the correct reserves will vary with the type of buildings under consideration. As a basis for this article, about twenty-five mill-construction buildings used for paper, textile, and machine-building industries, and costing from $1.25 to $1.50 per square foot, have been selected. The rates given above for depreciation and repairs were used in these mills, and appear to be correct, judging from accumulated cost-accounting records.

The cost of the first three elements—fixed charges on land, buildings, and fixtures—was determined then by calculating proper annual interest, tax, insurance, depreciation, and repair charges as a percentage of the appraisal value of the land, buildings, and fixtures.

The next two elements (power, heat, and light) include the cost of power used for lighting buildings and operating elevators, and the cost of steam used for heating. These costs are, of course, based on a determination of how much power and heat is used for these purposes, and how much it costs to make the power and steam in the particular plant.

The amount of steam used for heating was estimated theoretically by the same methods which would be used in designing a heating system for a mill building, and these theoretical results were checked with the known difference in coal consumption between winter and summer months due to heating. Power used for lighting was frequently developed by a separate generator, which enabled a log of switchboard readings to be used in making this determination. In a few cases power for lighting was purchased. Power used by elevators is, in most cases, a relatively small item and depends on the size of the elevators and the frequency with which they are used.

In determining the cost of the steam and power used, fixed charges on land, buildings, fixtures, and equipment, as well as operating charges for fuel, labor, supplies, etc., are included. In the several plants under discussion the average cost of steam was 30 cents per 1,000 pounds, and of power was 2 cents per kilowatt hour. The cost of power, heat, and light was determined then by estimating the power, heat, and light used, and calculating the cost, taking into consideration the cost of power at the plant in question.

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* Production Factors in Cost Accounting and Works Management. By A. Hamilton Church.

The last element, buildings expense, is made up of expense items attendant upon the operation of practically all factory buildings. Under this head has been included labor, such as watchmen, elevator operators, janitors, etc., and the cost of supplies used for cleaning buildings, the cost of water for general factory use, and other similar items.

An attempt has been made in the preceding paragraphs to describe definitely how the total land and buildings factor has been determined. If this has been done, the data following should have a practical value for comparative purposes, and this discussion should serve as a basis for a study of buildings-factor costs with the object in view of approaching a maximum efficiency.

The average cost of a square foot of floor space, in the buildings as explained in the previous paragraphs of this article, was 22 cents. As an illustration of the meaning of this cost, take the case of a boring mill in a machine shop which may occupy a space 20 feet by 20 feet, when allowance is made for the machine, the operator, and the necessary movement of work at the machine. A square-foot factor or buildings factor of say 25 cents would mean that it costs 20 x 20 x 25 cents, or $100 a year to house this machine. Assuming a working time of 2,500 hours a year, it would mean that this cost accumulates at a rate of 4 cents an hour. This buildings-factor charge is an appreciable percentage of the wages paid the machine operator, and is but one of several equally important factors making up the total burden of the industry.

Relatively, the buildings-factor charge was found to be divided between the elements as shown in the next column:

Division of a Typical Buildings-Factor Charge

	Per cent.	Cents.
1. Fixed charges on land	10	2.2
2. Fixed charges on buildings	56	12.3
3. Fixed charges on buildings fixtures	9	2.0
4. Power and light	4	.9
5. Heat	14	3.1
6. Buildings expense	7	1.5
Total	100	22.0

From a study of buildings-factor charges in a large number of plants, the percentages and costs given above have been selected as being those which are attained in average practice. If, in a given plant, any of the above elements are materially greater than the averages shown above, the reason should be at once apparent. The factory site may be on valuable land, the buildings may be of an expensive design, heating and lighting systems may be inefficient, and items chargeable to buildings expense may need investigation.

By far the most important item is that of fixed charges on buildings. The selection of good building materials when making repairs or additions offers an opportunity for a reduction in depreciation and repair charges, which cause about half of this expense. The amount of interest charged to cost will be increased, but the savings in depreciation and repair charges will usually compare very favorably with this amount. Interest and tax charges on land may be decreased by the selection of a cheaper site, and there are many cities offering such locations to desirable industries at the present time. Insurance charges may be lowered by making a few changes in fire-protection equipment, and by insuring with mutual companies, with whom very low rates may be secured.

And after building site and building materials have been selected, and each of the fixed charges lowered as much as possible, the building designed to give the greatest amount of floor space for a given cost will reduce the buildings factor greatly. Or if it is desired to erect a new building to provide a definite amount of space, it is well known that it will be much cheaper to construct a wide building four storeys high than to attempt to get the same amount of space in a one or two-storey building covering a much larger ground area. All the above considerations affect the resultant buildings factor, and the cost per hour of housing every machine in the plant.

Lighting and heating-system costs can be checked also. If lighting costs are high, the equipment may be at fault, lights may be poorly placed, they may be of a design which takes more power than a better lamp would need, or the cost of the power itself may be too high. Excessive heating costs may show that the design of the system is at fault in respect to the location of heating surfaces, the needless exposure of heating surfaces to outside tempeartures, the disposition of returns from the system, the methods of circulation, etc., or again the cost of the steam itself may be too much.

A reduction in buildings expense may be secured by an investigation as to the necessity, or as to the economy of use, of the items going to make up this element.

In conclusion, then, the organization that can secure a cheap site, that can occupy buildings of good construction and of economical design, that can install efficient heating and lighting apparatus, and that can provide for the proper care-taking of their property, will have the lowest buildings-factor charge, and will have made an important step toward a maximum efficiency in one of the largest factors making up the burden of an industrial organization.

High-Alloy Steel for Bridges

High-alloy steels for bridges have been discussed at some length by J. A. L. Waddell in a paper presented before the American Society of Civil Engineers. In closing the discussion on this paper, in the "Proceedings" of the Society for October, 1914, Mr. Waddell gives the following conclusions:

1. Titanium as a scavenger of carbon steel promises good and useful results at exceedingly low cost. Although it does not increase greatly the elastic limit or the ultimate strength of the metal, it makes it much more uniform and reliable. On this account it should be used in a few cases on bridge work; and then, if it be found satisfactory, its adoption should be made obligatory by railway companies and other builders of carbon-steel bridges.

2. There appear to be great possibilities in the use of aluminium as an alloy for bridge steel. But, very few experiments in aluminium steels have yet been made; hence, the possibilities are more or less hypothetical.

3. The possibility of obtaining a good, high-alloy steel for bridges by the use of vanadium appears to be a settled fact. But the highest elastic limit and ultimate strength which can be obtained on a commercial basis by the use of that element cannot be determined without elaborate and exhaustive experiments.

A committee of the Montreal Builders' Exchange has been appointed to ask the council to pass a bylaw by which the city will be able to accept guarantee bonds or bid bonds in lieu of a cash deposit or a marked cheque, at the option of the tenderer, in submitting a bid for municipal contracts.

The Contractor and Engineering Problems in the Home

By Chas. F. Smith

ONE may have a house of elaborate design, architecturally a thing of beauty; a glorious addition to the landscape; the interior artistically furnished; but, if the plumbing, heating and lighting equipments are faulty the house remains unsatisfactory and loses its charming title of "home" to the occupants, and becomes merely an uncomfortable residence. It may also be absolutely dangerous to health and life from defective plumbing or heating, and seriously impair the health of the occupants by improper illumination.

It behoves the contractor, therefore, to thoroughly acquaint himself with the different systems of heating and lighting, and the methods and materials to be employed to insure the installation of sanitary plumbing, heating, and lighting equipments, in order that he may not only satisfy the owner of the building he is erecting, but satisfy himself as well, that all has been done that lay in his power to safeguard the occupants from any improper or imperfect installation.

Many contractors are content to go on year after year duplicating the heating or plumbing equipment in every house they build, principally because they have some "friend in the business" who can install the plant at a reasonable price, and they fail to give the efficiency of the plant a thought, nor do they care much whether there is anything better to be had or not.

The "friend in the business" may be honest enough in his intentions to give good value for the money received, but he, too, is likely to be shortsighted and adhere too closely to old deals and customs, ignoring, entirely, improvements in apparatus and methods, no doubt more from ignorance that any exist, because of his lack of ambition to acquaint himself with modern methods, than from any real desire to adhere so closely to venerable systems.

Many manufacturers state with absorbing pride that their productions have been on the market thirty or forty years. That is all very well so far as it goes, and it does indicate a more or less successful business and the ability to keep alive; but, as a matter of fact, if no improvements have been made in their productions during the past ten years they are out of date and lag far behind in the race for real success. The world is moving swiftly to-day, and wonderful improvements are being made in all lines of human endeavor, and in none greater than in the building line and all that pertains to it; consequently the contractor who desires to keep up with the times must post himself thoroughly on all the changes and improvements in his business, and maintain a compelte list of catalogues for the benefit of himself and his clients.

There is no part of the equipment of a building, new or old, which is of greater importance than the plumbing. The health, and even life itself, depends in a great measure upon the efficiency of the plumbing. A small leak in the piping, a defective trap to any of the fixtures, or a fixture itself which accumulates foul matter and is not readily cleaned, becomes a very serious menace to the health of the occupants of the building by the admission or culture of typhoid and malarial germs. The greatest care should be exercised in the erection of the piping, which should be only of extra heavy cast-iron pipe, uncoated, or galvanized wrought iron, clear of any obstructions, and free from any defects, cracks, blow holes, etc.; the cast-iron pipe securely caulked with picked oakum and pure lead to make a good tight joint; very little lead pipe should be used—it is liable to be punctured by nails during erection, or by rats and mice afterwards, and in the case of water pipes is sometimes dangerous, as some waters absorb lead in sufficient quantities to eventually become poisonous, lead being a cumulative poison. No one to-day with the least pretentions to advancement would consider resorting to the old unsightly and unsanitary privy vault, which of course can only be used in country districts anyway, where there are no sewers. In such cases the best substitute where one has running water in the house is the septic tank, which treats the sewage without chemicals. The effluent passing through a filter bed is odorless and harmless, and the entire system requires practically no attenton.

Another very good system, in use where water is not available, is a chemical system, using a tank somewhat similar to a septic tank, except that there is no overflow; no filter bed and no water is used with it, the tank being charged with a chemical which disintegrates the solid matter and destroys the germs and foul odors. The tank is pumped out at long intervals and recharged. A porcelain bowl or toilet is furnished with this system.

Both systems give entire satisfaction, are thoroughly sanitary, inexpensive to install or maintain, and are certainly a great boom to the suburban or country districts.

Usually in the town or city where sewers are provided, a sewer connection for each house is compulsory; but the sewage disposal of the city is rapidly becoming a very serious problem. The present plan in the great majority of cases is to have the sewers discharge into a lake or river, or, at the seaboard, into the ocean; but this plan is having the very natural result of polluting our navigable waters to so great an extent as to become positively dangerous to the health of our cities. It is a question if, after all, the answer may not be the use by each house of an individual septic or chemical tank as above described, the harmless effluent then being discharged into the sewer, the sludge when of sufficient quantity being removed separately and otherwise disposed of. It would not be the first important problem solved by the rural district.

Having decided upon our system of sewage disposal, the plumbing fixtures must claim our attention. Generally speaking, all porcelain toilets or water closets look very much alike to the owner of the house and often to the builder as well; there is a difference, but more in the type than in the construction or finish. The one type to be adjured, regardless of price, is the so-called washout closet either front or back connection; the water seal is shallow and easily broken, admitting the foul gases to the house; there is never sufficient depth of water in the bowl to cover the soil, and it is rarely indeed that the bowl is cleared by one flushing; in fact, it is an unsanitary closet in all respects, and its use should be prohibited. The other types, wash down or syphon jet, as made by any of the manufacturers, are reliable and sanitary, and cost very little more for the same finish than the objectionable "washout." It should be remembered that, where a chemical sewage tank is used the water closets just mentioned cannot be used, as a special closet is provided by the manufacturers of that system. To be really sanitary kitchen sinks and lavatories should be in one piece, and either galvanized or porcelain lined, the latter of course preferred; there is then no chance for the accumulation of foul matter in the joints, as there is with made-up fixtures.

There is nothing more attractive as a bath in our modern home than the porcelain-lined tub; but wth it should also go a nickel-plated shower with a mixing column to secure the right temperature of water; one may rinse off well and obtain the best results from the bath.

It is not often that a builder will have a client or owner who knows just exactly what he wants and is able to specify it. In nearly all cases the contractor is expected and desired to make suggestions to his client regarding various features and conveniences desirable to include in the house, and there is surely no convenience of greater importance than an abundant supply of hot water on tap at all times during the winter months, with a good fire in the range at all times, and another in the furnace or boiler which can also be used for that purpose if desired, it is an easy matter to have plenty of hot water, but in the summer, when the fires are out, or the range in use only occasionally, it is different; and at such times, or even at night during the winter when the fires are banked, the automatic gas heater is of very great service. It is assumed, of course, that gas is to be in the house—either city gas, acetylene, or gasoline gas in some form; the heater is automatic in either case, and after being once lighted requires no further attention. Can a greater convenience be imagined? Nothing but the pilot light burning, so small as to be scarcely discernible. Turn on a faucet in any part of the house, and immediately the flame is on full blast, and we have hot water. It is always better to use a heater with a double coil. The first cost may be greater but it is more economical in operation.

There is no excuse for a lack of conveniences even when remodelling an old house, as they are all easily installed, and improvements in methods and manufacture have brought the prices of the various appliances down within the reach of every one able to own a house; it resolves itself merely into deciding what particular appliance to select.

One appliance, perfected only during the last few years, and yet needed ever since coal has been in use, is the modern coal chute; the most approved form is provided with a hinged cover which opens up against the house, to protect the latter from being defaced when the coal is shovelled in. The cover is of glass, in a metal frame, and may be securely locked from the inside; it should also be provided with side plates. It should be located in a position that will deposit the coal conveniently to the furnace and also be accessible to the kitchen range.

The open replace is very much in vogue just now in the living room, and in many cases in the dining room also; in fact, it amounts almost to a renaissance of colonial days. They are so attractiv as to be almost irresistible, but for heating the room they are sadly inefficient, and need to be supplemented by some other method; although they do add very materially to the ventilation, provided the chimney damper does not close so tightly as to throw the smoke and gases into the room, as it then becomes positively dangerous. However, by the use of the improved damper mechanism for the fireplace, this trouble cannot occur, as the damper is controlled by a mechanism which renders the fireplace far more efficient than formerly by permitting better control of the fire, with less loss of heat.

Where the winters are not too severe the hot air system of heating with the furnace is satisfactory, and it provides better ventilation than either steam or hot water; but the furnace must be of ample size for the work, and provided with large radiating surface; and the cold air duct should extend clear across the house, wth an inlet at each end controlled by light cloth flap valves and a cut-off damper. A mistake made by many people operating a furnace is to close the cold air damper in very cold weather to keep the cold air out, when, in fact, they should do just the opposite, as additional heat with the furnace can only be obtained by the admission of a larger volume of air. There are many excellent furnaces in the market to-day, of cast-iron, steel, or galvanized iron, portable or brick set; but any one should contain a large, deep fire pot, as this is the very life of the system, be accessible for cleaning, and also contain a water pan of very liberal area, because if the air is not moistened when passing through the furnace the furniture and wood work about the house will be dried out and crack, and the occupants of the house will feel as though they were living in the Desert of Sahara.

There are some advantages in hot-water heating over steam heating. It is easily controlled and has a greater range than the steam system. It is not often that the full power of the plant is required; most of the time only a moderate heat is required, and then the water system has the advantage; but the radiation must be ample for the most extreme cases, and, as the temperature of the water is not so high as the steam, the initial cost of the installation is higher because more radiation is required.

There are systems of steam heating in use now which require only atmospheric pressure for complete circulation, keeping the temperature down to 212 degrees, and permitting close regulation at each radiator of the heat required. There are also governors, or automatic controllers with a time clock attachment which can be set to open the draft of furnace or boiler at any hour of the morning, assuring a warm house at getting-up time, and they also control the draft during the day, insuring close and economical regulation of the fire.

There are many different makes of steam and hot-water heating boilers, of steel and cast iron, the latter of the sectional type, with underfeed, hopper feed, and plain shovel feed; the underfeed is economical in operation, and can use a cheaper grade of fuel than the others, and is likely to be smokeless when burning soft coal if properly handled.

In all cases with a steam boiler it is advisable to get one with a low water line to insure better circulation with the lower radiators.

Any of the manufacturers, if furnished with a sketch of the floor plans, giving the heights and other dimensions together with location and size of windows, will gladly supply complete heating plans, with an estimate of the cost of installation, and be willing to guarantee results if their plans are followed.

The modern house is not complete without modern lighting. If it is located in the city or town where gas and electricity are available it is an easy matter to have both, but where neither is available from a town supply, it becomes necessary to have an isolated plant of some kind. The electric plant operated by a gasoline engine is compact, convenient and easy to handle. Unless, however, the house is an unusually large one, or on a farm where some power can be utilized, it is not so desirable as a gas plant.

Some of the gasoline generators are operated by a weight which needs to be wound up at intervals, others by passing heated air over the gasoline. Both types are automatic and require very little attention. The weighted type is the larger and more dependable.

The acetylene is generated by dripping carbide into water, or water on to carbide, the former being the better method. Many different types and styles of generators are in the market, operating both ways. Undoubtedly acetylene is the safest, and, generally speaking, the most satisfactory illuminating gas we have, it being about as economical as any in cost of installation and operation when the illumination in candle power is considered.—National Builder.

New Street Lighting System at Outremont

A new street lighting system, designed by Dr. L. A. Herdt, of McGill University, has just been put into operation by the town of Outremont, P.Q., the first Canadian city or town to have its entire street lighting served by underground cables. The lamps are of the 6.6 ampere nitrogen-filled tungsten incandescent type. The power is supplied in bulk at 2,200 volts to a sub-station and transformed with 25 kv.a. 2-circuit constant current regulators. The town is wired for ten separate circuits supplied from five regulators, the circuits being arranged so that damage to a regulator will only affect two small areas at different parts of the town, and will not disturb the entire system. The total number of lamps is 498, and approximately two miles of streets are illuminated. There are two sizes of lamp—a 400 candle power on streets where there are tramway car tracks and a 250 candle power on other thoroughfares. The lamp standards are of the bracket type, and on the tramways route a combination pole is used to allow of the attachment of the trolley span wires. The standards are spaced 200 feet apart on one side of the street, and the same distance on both sides on the tramways route. All the equipment is of Canadian manufacture, the total cost being about $75,000. Mr. Duchastel, the town engineer, supervised the installation. The standards were made by the William Hamilton Company, Peterborough, Ont., while the 6,600 volt rubber-covered cable for the standards and the nitrogen-filled tungsten lamps were supplied by the Northern Electric Company, Montreal.

It has been decided to commence work on the construction of the aqueduct for the Greater Winnipeg Water District early next March. Excellent progress has been made on the undertaking this season. Details of the work were given in an article, entitled, "The Greater Winnipeg Water Supply from Shoal Lake," published in our issue of December 2nd.

"Genuine Economy in Home Building" is the title of an interesting, well-illustrated booklet received from the Hydraulic-Press Brick Company, St. Louis, Mo., makers and distributors of Hy-tex face brick. The illustrations are beautifully colored and bring out to great advantage the possibilities of the material.

CONVENTION NEWS

The American Concrete Institute will convene at Chicago from February 9th to 12th. The Secretary is Mr. E. E. Krauss, of Philadelphia.

The Annual Convention of the British Columbia members of the Canadian Society of Civil Engineers was held at the Empress Hotel, Victoria, B.C., on December 12.

The Annual Meeting of the American Society of Engineering-Contractors will be held in New York City on January 15th. Mr. J. R. Wemlinger, of New York City, is the Secretary.

The Association of Government Contractors (U. S.) will hold their Annual Meeting at Washington, D.C., next month (January 4th to 7th). The Secretary is Mr. Algernon Blair, of Montgomery, Ala.

The Eleventh Annual Convention of the American Road Builders' Association is now being held at Chicago. The dates of the meetings are December 14-18. The President is Mr. W. A. McLean, Toronto, and the Secretary, Mr. E. L. Powers, 150 Nassau Street, New York.

Mr. W. A. McLean, Toronto, President American Road Builders' Association, now in session at Chicago.

The Society of Constructors of Federal Buildings will hold their Annual Convention at Washington, D.C., next month (January 4th to 6th). The Secretary is Mr. T. R. Maul, of Philadelphia, Pa.

The American Society of Heating and Ventilating Engineers hold their Annual Meeting in New York City next month (January 20th to 22nd). The Secretary is Mr. J. J. Blackmore, of New York City.

The Annual Meeting of the Victoria Branch of the Canadian Society of Civil Engineers for the election of officers and the transaction of general business was held on December 9. The Secertary of the Branch is Mr. R. W. Macintyre.

As announced in our issue of December 2, the annual convention of the Canadian National Clay Products Association is to be held at the King Edward Hotel, Toronto, January 26-28 next. We now learn that Mr. Daniel A. Lochrie, a well-known member of the Association, and proprietor of the Park Theatre, Toronto, has placed his theatre at the disposal of the Association for Tuesday evening, January 26, when special films, illustrating building construction, will be shown. The following is a list of speakers, with the subjects of their addresses: Dr. A. C. McKay, President of Toronto Technical Schools, "Toronto Technical Schools and their Relation to the Manufacture of Clay Products"; Mr. W. W. Smith, Shallow Lake, Ont., "The Making and Burning of Drain Tile"; Mr. A. F. Greaves-Walker, Manager, Sun Brick Company, Toronto, "Kiln Kinks"; Mr. E. W. Knapp, "Possibility of Manufacturing High-Class Paving Bricks in Ontario"; Mr. Andrew Kruson, "Cheap Glazes for Use on Ontario Clays and Shales"; Mr. Philip W. Green, "Standardization of Clay Products from an Architect's Point of View."

The merging of national road conventions in an All-American Road Congress at San Francisco in 1915 during the exposition, was foreshadowed in a meeting of the Directors of the American Highway Association held in Washington recently. The Board authorized a committee of two members to meet a like committee from the American Road Builders' Association, these four to choose a fifth member and thus form an executive committee to handle the great road congress. The two associations named have in their own ranks or immediately identified with them practically all of the recognized official and unofficial good roads workers in the United States and Canada. At the Road Congress held recently in Atlanta, Georgia, by the American Highway Association and its allied organizations, upwards of four thousand delegates and visitors were registered. At the convention at present being held in Chicago under the auspices of the American Road Builders' Association, it is expected that the registration will not be far short of the Atlanta attendance. The combining of these two great meetings should result in an attendance of from 7,000 to 10,000.

Personal Mention

Mr. Jas. R. Valk has been appointed Western Sales Manager for the United States Asphalt Refining Company, New York. Mr. Valk's office will be in the Harris Trust Building, Chicago.

Mr. J. S. MacLachlan read a paper, entitled, "Victoria Breakwater Construction" (illustrated by lantern slides) before the Victoria Branch of the Canadian Society of Civil Engineers on December 11.

Mr. W. W. Pearse, City Architect, Toronto, will address the Canadian National Clay Products Association at the annual convention of that body which is to be held at the King Edward Hotel, Toronto, January 26-29, 1915.

Mr. J. S. McCannel, president of the Milton Pressed Brick Company, Milton, is scheduled to deliver a paper, "Steam Shovel for Handling Shale and Clay," at the convention of the Canadian National Clay Products Association, which is to be held at Toronto, January 26-29, 1915.

In connection with the appointment of Mr. Georges Janin as Major in the corps of engineers which he was largely instrumental in raising at Montreal, and having in mind the probability of his leaving the country on active service shortly, it is of interest to note that as chief engineer of the city of Montreal, at a salary of $9,000 per annum, Mr. Janin is the leading member of the municipal engineering profession in Canada. With this in mind, and seeing that Mr. Janin is 61 years of age, his example in offering his services to his country is particularly commendable.

Announcement is made of the death of Mr. W. J. Tregillus, of Calgary, well known in that city as the founder of the Tregillus Clay Products, Limited. The late Mr. Tregillus, who was a native of Plymouth, England, was active in civic and provincial circles. He was serving the city as an alderman and he was a Governor of the University of Calgary.

Mainly Constructional

East and West—From Coast to Coast

EASTERN CANADA

The ratepayers of Hull, Que., will vote in January on a bylaw to raise $100,000 for water-works extensions.

At the January elections, the ratepayers of Brantford, Ont., will vote on a bylaw to raise $100,000 for the completion of the water-works plant.

The ratepayers of Guelph, Ont., will vote next month on a by-law to authorize the expenditure of $125,000 for an addition to the Collegiate Institute.

Foundation work has been completed for the new school building which is to be erected on Givens Street, Toronto, for the Board of Education at a cost of $165,000.

At Toronto, the Works Committee have approved of a street extension through Mount Pleasant. The work, which will cost $275,000, will include the construction of a bridge over the old Belt Line.

On the occasion of his recent visit to Toronto, Sir Robert Borden made a complete tour of the harbor work now under construction. He was accompanied by the Mayor and the members of the Harbor Commission.

For the Danforth section of the Bloor Street Viaduct, the Toronto City Council has accepted the tender of Messrs. Quinlan & Robertson, of Montreal, at $947,076, for steel construction, lower deck to be completed in future.

The ratepayers of Peterborough, Ont., will be asked to vote next January on a bylaw in favor of the Canadian General Electric Company, who propose to spend $150,000 on plant and equipment for the manufacture of railway cars.

Tenders close December 24 with Messrs. Burke, Horwood & White, Toronto, for the erection of the Masonic Temple which is to be built on Spadina Road at a cost of $300,000. Mr. H. B. Knowles, New York City, is the architect.

Messrs. Barnett & McQueen, Fort William, Ont., are the successful contractors for the new grain elevator which the Dominion Government is erecting at Vancouver at a cost of some $700,000. The building is to be of reinforced concrete and steel construction. Its capacity will be 1,250,000 bushels.

The Montreal Builders' Exchange have objected to the City Council's advancing the wages of the laborers from $2.25 to $2.50 a day, in view of the fact that the current rate for building laborers is $1.50 a day. It is suggested that instead of advancing wages the Council should find more employment.

At Toronto, the Board of Control have approved the recommendation of Mr. R. C. Harris, the Works Commissioner, that a road shall be opened through Mount Pleasant Cemetery at a cost of $275,000. Two small bridges—one a 112-ft. footbridge and the other a 180-ft. trestle—will be erected.

The new assembly hall which St. Patrick's Parish is erecting on Dorchester Street, Montreal, is nearing completion. The building is of stone and brick construction and has cost $135,000. The architect was Mr. J. P. Hynes, and the general contractors were Messrs. John Quinlan Company, both of Montreal.

From Sydney, N.S., comes the gratifying report that two thousand men are employed at the Dominion Steel Company's plant. This is more than two-thirds of the full force in the busiest times. Rod, bar, nail, wire and billet mills are working full time, double shift, and a ten thousand ton order of rails is being rolled. Four shipments of wire have been sent to England, and other shipments will follow as soon as possible.

At Montreal, work has started on the concrete subway under the C. P. R. tracks at Park Avenue. The engineer in charge is Mr. J. Emile Vanier, of Montreal, and the general contractors are Messrs. Laurin & Leitch, Montreal. The Dominion Bridge Company have the contract for the steel work. The estimated cost of the undertaking is $176,000.

The Toronto-Hamilton Highways Commission, of which Mr. George Gooderham, of Toronto, is Chairman, have under consideration draft plans for a high level bridge at Carroll's Point, Hamilton, Ont. The plans were prepared by the Hamilton Bridge Company and the estimated cost is $327,000. The proposed undertaking will be financed by the city of Hamilton and the County of Wentworth.

The new church which the Capuchin Fathers are erecting at Fairmount and Wellington Streets, Ottawa, at a cost of $156,000, is nearing completion, although work has not yet started on the interior. The architect is Mr. Chas. Brodeur, Hull, Que., and the general contractors are Messrs. Noel & Monette, 567 St. Patrick Street. The building is 67 x 241 ft. in dimensions, of brick construction.

WESTERN CANADA

Road improvements estimated to cost $100,000, have been authorized at Port Coquitlam, B.C., by the local council.

It is of interest to note that the ratepayers of West Vancouver have approved a bylaw to raise $150,000 for the installation of a water-works system.

The municipal council of Saanich, B.C., are advancing two schemes of road improvement—the Shelbourne and Lake Road extensions. The estimated cost of the proposed work is $80,000.

The Taylor Engineering Company, Limited, Vancouver, B.C., has been incorporated with a capital of $50,000. The new firm will manufacture mechanical and electrical machinery and appliances.

A noteworthy contract awarded recently by the Dominion Government was that for the new elevator at Vancouver. The successful contractors were Messrs. Barnett & McQueen, and the price was $690,000.

The value of Vancouver's building permits for the eleven months ending November 30 was $4,445,000. The permits last month, which amounted in value to $1,585,000, just trebled the figures for November last year.

Excavating has been completed for the new Great Northern Railway station at New Westminster, B.C. The actual construction of the building will be started as soon as the plans have been approved by the Railway Commissioners.

The services of Mr. Thomas Adams, Town Planning Adviser to the Commission of Conservation, have been placed at the disposal of the Civic Centre Committee of Vancouver in connection with the plans submitted in the recent competition.

At Prince Rupert, a start is about to be made on the construction of a new court-house for the Provincial Government. At the time of writing no contract has been awarded, but excavating (by day labor) is to be started shortly. The architect is Mr. A. A. Cox, of Vancouver.

The court-house at Swift Current, Sask., which has been erected at a cost of $103,000, is nearing completion. The building is two storeys high, 100 x 75 ft. in dimensions, of stone, brick and reinforced concrete construction. The general contractors are Messrs. R. J. Lecky Company, Limited, Regina.

The McLeod Block, which is being erected on the corner of Rice and McDougall Streets, Edmonton, at a cost of $600,000, is nearing completion. The building, which is of fireproof construction, is nine storeys high and fronts on McDougall 118 feet and on Rice 100 feet. The outside finish is in cream brick, and terra cotta, plain with half cornice in classic style over all. The contractors are Olsen & Jackson, and the architect John K. Dow.

The new provincial jail at Regina has been officially opened. The jail at present consists of the main cell block, 60 by 200 feet, and administrative building, 50 by 80 feet, with kitchen and chapel block about 40 feet square. The building is three storeys in height, and is built of brick, stone and reinforced concrete construction, it being fireproof throughout. The plans make provision for another block of similar dimensions, but it will not be built until required.

Up to November 20 the Greater Winnipeg Water District had expended $1,413,605, according to the statement contained in the report of the Commissioners. The canal being constructed by the Northern Construction Company, Limited, to improve the Brokenhead River, is completed, and the dredge has been taken out. The entrance to the south end will be improved by hand labor. The Northern Construction Company, Limited, will also construct a gravel pit spur on the orders of the commissioners.

Mr. David McGill, dealer in building supplies, has removed from 83 Bleury Street to 320 Lagauchetiere Street West, Montreal.

The following are now the sales engineers of the Canadian Sirocco Company, Limited, of Windsor, Ont.: A. M. Nichols, 301 McGill Building, Montreal; C. T. Morse, 43 Victoria Street, Toronto; W. P. Eddy, 301 Tribune Building, Winnipeg; S. S. Clarke, 605 2nd Street, Calgary, Alta.

The Merits of Creosoted Block Pavement

It will be interesting to readers of the Contract Record to learn that the Canada Creosoting Company, Limited, of Toronto and Trenton, Ont., have appointed The Creosoted Block Paving Company, Limited, 76 Adelaide Street West, Toronto, sole agents for the sale of creosoted wood paving blocks. This company have been formed only recently and are to be entrusted with the laying and guaranteeing of the block that is creosoted at Trenton. Messrs. W. G. Campbell and C. H. Lattimore, of the contracting firm of Campbell & Lattimore, together with Mr. J. L. Boyd, who is also well known in contracting circles, are directors of the new company, in whose hands we are sure the interests of the public will be closely supervised.

Modern wood pavements are increasing in popular favor more and more every day. Prior to 1900 the supply of wood block pavements on this continent was comparatively small. To-day they are to be found in all the principal cities of the world.

In connection with this pavement a few detailed particulars concerning the treatment of the blocks by way of preparation will not be out of place. Blocks are treated at the factory in cylinders filled with creosote oil and a pressure of approximately 150 lbs. per square inch is applied until the blocks have been filled with the required amount of oil. This prevents the decay of the wood and also renders the blocks impervious to moisture. The blocks are laid on concrete of such thickness that there is no chance of the weight of traffic breaking through. It is claimed for creosote wood paving that it is immune from wear, extremely durable, renders heavy traffic practically noiseless and has proved its superiority to paving of every kind from all viewpoints.

Contracts Department

News of Special Interest to Contractors, Engineers, Manufacturers and Dealers in Building Supplies

Waterworks, Sewerage and Roadways

Brantford, Ont.
A bylaw will be submitted to the ratepayers at the January election to authorize the raising of $100,000 to provide for the completion and extension of a water-works system now under construction for the city council. Mr. F. W. Frank is secretary-treasurer. Messrs. Chipman & Power, 204 Mail Building, Toronto, are the engineers.

Halifax, N.S.
Tenders will be received by Mr. E. H. Armstrong, Provincial Government Public Works Commissioner, until noon December 31, for the construction of 113 culverts in Annapolis County. Plans and specifications are at office of Mr. W. G. Parsons, Middleton; Mr. O. S. Miller, clerk, Bridgeton; Mr. I. J. Whitman, Torbrook; Mr. J. E. Shaffner, Annapolis, and at Department, Halifax.

Kamloops, B.C.
The municipal council (Light & Power Department), will borrow $35,000 for extension to water-works and $40,000 for extensions to electrical power plant. Mr. J. J. Carment is city clerk. Mr. C. North is Supt. of Department.

London, Ont.
The construction of tile sewers on the following streets is contemplated by the city council: William Street, from Cheapside to Victoria Street, $2,168.90; Colborne Street, from Horton to Bathurst Street, $737.73; Langrath Street, from Cathcart to Edward Street, $2,238. Mr. W. N. Ashplant is City Engineer.

London Township, Ont.
A by-law will be submitted to the ratepayers about January to authorize the construction of drains by the township council. Tenders will be called about February or March. Mr. F. W. Farncomb, Bank of Toronto Chambers, London, is the engineer.

Lindsay, Ont.
The town council is having plans prepared for the construction of a sanitary sewer and cellar drain on Regent Street, at an estimated cost of $4,940. 6-in. and 9-in. glazed pipe is to be used. Mr. A. J. Williams is town commissioner and engineer.

North Dorchester Township, Ont.
Work is to start immediately on the laying of drain for the township council at an estimated cost of $2,212. Messrs. Moore & Parry, Gladstone, Ont., are the general contractors. Mr. W. B. Lane, Dorchester Station, Ont., is the town clerk.

North Easthope Township, Ont.
The general contract for the construction of Krampian drain, embracing approximately 700 ft. of tile, has been awarded by the township council to Messrs. Crowley & McDonnell, Gadshill, at $2,494. Mr. J. D. Fisher, R. R. No. 1, Stratford, is the township clerk.

Ottawa, Ont.
The construction of a tile pipe sewer on Bank Street, between Cameron and Riverdale, is contemplated by the city council.

Tenders for 12-in. pipe will be invited next month in connection with the laying of water mains on Bank Street at an estimated outlay of $12,000, for the city council. Mr. R. L. Haycock is Water-works Engineer. This work will not be started until next spring.

The city council has started work on the laying of asphalt and stone block between Gladstone and Arlington Avenue. Surface drainage has been started by day labor. Tenders for balance of work will be called soon. The work is estimated to cost $12,000. Mr. F. C. Askwith is City Engineer.

Toronto, Ont.
Time has been extended until December 22 for the receipt of tenders to supply 567 ft. of 48-in. cast iron pipe and 400 ft. of 66 in. cast iron pipe. Plans are at office of Mr. Harris, Commissioner of Works.

Winnipeg, Man.
Plans are in progress for the following alterations to boiler plant for Municipal Hospitals as follows: installation of water supply, $885; forced draft apparatus, $610; shaker grates, $412; trap and receivers, $1,250. Pumps, valves, fan and accessories will also be required. Work may be carried out by day labor. Mr. W. P. Brereton, 223 James Avenue, is the engineer, the consulting engineers being Messrs. Roberts & Frith, Canada Building.

West Vancouver, B.C.
The ratepayers have approved of a bylaw for the carrying out of a waterworks system here at a cost of $150,000, work to start early next year. The scheme will include piping from Sister's Creek, where a dam, 26 ft. high, by 10 ft. long will be constructed. A large quantity of material will be purchased. Mr. H. McPherson is the engineer.

CONTRACTS AWARDED

Toronto, Ont.
Contracts as follows have been awarded by the Board of Control for the construction of sewers: Godson Contracting Company—East Lynne, $1,947, West Lynne, $2,730, Indian Road, $1,692, Maberly, $1,245; Grant Contracting Company—Annette Street, $350; Orpen Company, Limited—Brighton Place, $568; R. J. Moyes & Company—Copeland, $2,480; Routley & Summers—Merrill Avenue, $647; Toms Contracting Company—Merrill Bridge Road, $847; Jennings & Ross—West Toronto sewers, Sec. No. 2, $23,500.

Railroads, Bridges and Wharves

Broadview, Sask.
Grading and pile testing has started on $40,000 steel and concrete bridge over Elcapo Lake for the Provincial Government Board of Highway Commissioners. Parsons Construction & Engineering Company, Limited, Regina, have the general contract. Mr. F. J. Robinson, Parliament Bldgs., Regina, is chairman and engineer.

Ottawa, Ont.
The city council has directed that tenders be invited at once for the contarct to construct a Bascule bridge across Pretoria Avenue at an estimated cost of $120,000. The city engineer is Mr. F. C. Askwith.

Province of Quebec
The Canadian Pacific Railway Company is constructing a spur and a siding in this province. The Grand Trunk Railway is also constructing an extension to siding in Parish of St. Bruno, Chambly County.

St. Catharines, Ont.
Tenders are in for contract to erect bridge superstructure on St. Paul Street, steel construction, 1,236 feet long, 41 feet wide, 89 feet high. The following are the tenders with the amounts: Canadian Bridge Company, $91,420; Hamilton Bridge Works, $97,425; Dominion Bridge Company, $101,879; McGregor & McIntyre, $112,012; Canadian Allis-Chalmers Company, $122,448; Standard Steel Cone Company, $133,360. Mr. W. P. Near is city engineer.

Toronto, Ont.
The city council has awarded the contract for the construction of Bloor Street Viaduct (Don Section), to Messrs. Quinlan & Robertson, Montreal, at $947,076. The specification for steel has been adopted and the viaduct will have five steel arch spans, with piers and approaches, concrete foundations. Length 1,618 ft., width 86 ft.

Mr. R. C. Harris, Commissioner of Works, has recommended to the board of control that the tender of Messrs. Quinlan & Robertson, Montreal, for the steel construction of Bloor Street Viaduct (Don section) at $947,076 be accepted.

Plans are drawn by the board of control for a new bridge which it is proposed to construct on St. Clair Avenue E., to replace present Moore Park structure.

CONTRACTS AWARDED

London, Ont.
The contract for the supply of shiffler poles at $3.33 plus 25c. a hundred loads for angle sections has been let by the London and Port Stanley Railway Company to the Canadian Bridge Company, Walkerville.

St. Catharines, Ont.
The city council has awarded the contract for a steel sub-structure to bridge on St. Paul Street, to the lowest tenderer,

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THOMAS S. YOUNG, General Manager.
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WINNIPEG - Telephone Garry 856 - 302 Travellers' Bldg.
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Alphabetical Index of Advertisers
Page 18

Vol. 28 **December 23, 1914** **No. 51**

Principal Contents

Page
Looking Ahead 1537
Scholarly Originality in Architecture 1538-9
Publicity for Engineering Work 1539-41
Floors for Steel Highway Bridges 1541-4
By Clifford Older
The Selection of Road Machinery 1544-7
By T. R. Agg
Water-Works Service Pipes 1547
General Principles of Snow Removal 1548
Tunnel-Boring Records Broken 1548-9
Characteristics of Materials 1549-53
By E. B. Tilt
Modern Practice in Refuse Disposal 1554-5
By Prof. E. R. Matthews
Problems of Railway Sanitation 1555-6
By E. J. McCaustland
Building and Equipment of Calgary's New Police Headquarters 1557-8
(Staff Article)
Constructional Features of a Large New Bakery at Montreal 1558-9
The Year's Building at Montreal 1559
Personal Mention 1560
Constructional News and Notes 1561
A New Device for Tying and Supporting Reinforcing Bars 1562
Opening of the Armstrong-Whitworth Plant at Longueuil, Que. 1562

Looking Ahead

It were a much better thing for municipalities, instead of devoting their time to a consideration of little economies in the way of reduced expenditure, to look ahead and see what money they can save in next season's work by getting it in hand well ahead of time and arranging the preliminaries now. This question is a perennial one, but it is of special significance at a time when conditions are so favorable to the municipality and capitalist.

In the leading editorial of our issue of December 9 ("The Day of the Capitalist and of the Prospective Builder") we dealt at length with the advantages offering just now in the way of competition among contractors, the low cost of material and the surplus of available labor, and it is unnecessary to reconsider this aspect. In this article we are discussing an advantage that is attributable to no temporary condition, but to established practice, experience and foresight. We all know cities that muddle along through their constructional programme year after year and repeat the same old performance of getting their paving operations and sewer construction tied up by bad weather; so that it is refreshing to find that a certain city engineer of a city of some 15,000 people cleared up 4½ miles of paving (brick and concrete curb) in one season before bad weather set in. In this particular case we learn that bids were received on January 28, 1914, from sixteen contractors, who showed keen competition for the work. There was no delay in awarding the contracts and work was under way early in March. Thus there was the advantage of cheaper labor and teams and the use of sleds for hauling—"all of which," the engineer tells us, "was to the material advantage of the city in the lower prices for the work."

OUR thoughts go out to our readers this Happy Christmas time, wishing them joy in all their deeds and days, —wishing them time for the task, wisdom for the work, peace for the pathway, friends for the fireside, and love to the last.

The contracts represented a total of 69,277 sq. yds. of brick paving and the work was completed by October 23 last. The sewers were built a year in advance of the paving, so that the trenches had plenty of time to settle before the paving over them was commenced. The contracts having been let in January they were the subject of much interest among local contractors, and an additional argument in favor of the whole procedure is that the streets were cleaned up before November, thus avoiding the danger to concrete occasioned by rapid and severe changes of temperature.

The case to which we have referred is not an isolated one. Harking back to last February, we recollect how the Maryland State Road Commission, in response to an advertisement (inserted about the end of January) for proposals on six contracts aggregating about thirty miles of road, received tenders from some fifty contractors whose bids totalled nearly one hundred. Surely there could be no better illustration of our point than this.

Dilatoriness is the bane of municipal life. Follow the procedure of the average council in the country, from the western hamlet to the eastern metropolis, and you will find the same governing characteristic of vacillation. This state of affairs is attributable, perhaps, to a basic defect in our form of government; but to whatever cause it owes its origin, responsibility should be placed directly on the shoulders of those who jeopardize the ratepayers' interests. City engineers and other civic officials must take a share of this responsibility whether their activities are directed by a competent or an incompetent council. **It is their business to know, and to let the council know, that the legal formalities and other preliminaries connected with public works must be arranged well in advance of the actual time of operations.** Too often these preliminaries are extended into the spring, with the result that there is unnecessary postponement and loss at the end of the season.

There is altogether too much procrastination in city construction departments, and a little lively action on the part of the local authorities, especially in the line of new work at a time when not too much is offering, would be refreshing. We look to our governing bodies for example, and our municipalities should take the lead in encouraging capitalists not only along the line of judicious expenditure but also in the way of foresight and getting the very best out of the work for the money put into it. This can only be effected by **looking ahead.**

Scholarly Originality in Architecture

(From the London Builder)

It is often maintained by designers of more confidence in their own skill than reasoning power that originality in problems of architecture implies a total severance from certain forms the origin of which is lost in the mists of tradition. These would-be arbiters of taste attempt at recurring intervals to alienate the sympathies of their less fortunate brothers from a study of historical motifs; they proclaim their dangerous enthusiasm for fresh adventure, yet every departure they attempt from the sequence of legitimate tradition ends in a burlesque of that which they profess to abhor.

Two definitions can be given to the term "originality"—each qualifies the other. In the first instance, the power to visualize the arrangement and proportion of an object or a group of parts depends entirely on a gift of concentration together with a profound knowledge of innumerable examples of like dispositions subconsciously carried in the mind as records of innumerable other circumstances. These impressions stored in the mind are so dimmed and blurred, and withal so great is their number, that it is impossible for them to be distinctly remembered; but on this depends the very soul of originality.

In the second instance, originality implies the power to variously modify, to readapt, to give new life to familiar shapes, to skim the surface of things and grasp their spirit; moreover, it means the power to recast universally accepted forms to meet new conditions without recourse to either caricature or eccentricity. In other words, originality is common sense allied to dexterity. But there remains a test even more severe for the designer who attempts the slightest variation from the orthodox—he must compare his work with other works of the highest reputation, and he must look upon all the masters of the past as dangerous competitors. If this theory is carefully followed the individual will gradually acquire a standard of impeccable taste; he will likewise comprehend the value of constructive criticism, which no true artist despises. All progressive art must of necessity be original; it invariably responds to the temper and spirit of the age which produces it. Great crises in the affairs of nations are eminently beneficial to originality; they are productive of disciplined art, which, moreover, is shorn of that undue luxuriance accompanying lengthy periods of peaceful prosperity. A glance at the picture which the nineteenth century offers affords the best illustration of the fluctuation of artistic ideals.

There should be no confusion of the terms "genius" and "originality." We have it on the authority of one of the foremost English essayists that "genius or originality is, for the most part, some strong quality in the mind answering to and bringing out some new and striking quality in Nature." In the latter regard it can be rightly argued that tradition is a convention of Nature.

The highly-strung artist whose temperament directs him to a pursuit of the ideal is the best qualified to dwell on the possibilities of scholarly original design. His knowledge of past achievement, however, must be of such a depth as to enable him to reject any theory unsympathetic with tradition. The ordinary man who dreams of airy castles almost attains to the status of an original designer, but such a one lacks the power to carry the given feeling into other situations, to convey the impressions of his imagination to paper and from that to the concrete. There are no rules governing the law of originality. The workings of the intellect in such circumstances are entirely by sympathy; there must be a passionate interest in a subject, a strong element of dissatisfaction, an even stronger desire to emulate and improve upon that which excites the fancy. Without passion there can be no original interest, none of that subtle and elusive charm, the attribute of all great works of art, which scarcely ever exists in the works of the present age.

A short time ago a brilliant writer and art critic who had gained some notoriety in the public press spoke to a gathering of architects. Most of the speaker's remarks were opposed to traditional sequence in the design of buildings; he ignored the theory of architectural composition, and bluntly told those present to be original. One illuminating sentence was, "Take ferro-concrete, and get something out of that."

As a champion of the modern school of amateurs this critic's arguments sounded plausible; but he, like many other gifted critics, was incapable of realizing that originality in design is a matter for slow development.

The Discourses of Sir Joshua Reynolds have stood the criticism of nearly a century and a half; nothing finer has been written on the subject of originality than certain of his remarks, which apply equally to architecture and painting.

In the second Discourse, given to the students of the Royal Academy, December 11, 1769, Sir Joshua said:—"A student unacquainted with the attempts of former adventurers is always apt to overrate his own abilities; to mistake the most trifling excursions for discoveries of moment, and every coast new to him for a new-found country. If by chance he passes beyond his usual limits he congratulates his own arrival at those regions which they who have steered a better course have long left behind them.

The productions of such minds are seldom distinguished by an air of originality—they are anticipated in their happiest efforts; and if they are found to differ in anything from their predecessors it is only in irregular sallies and trifling conceits. The more extensive, therefore, your acquaintance is with the works of those who have excelled the more extensive will be your powers of invention, and, what may appear still more like a paradox, the more original will be your conceptions. But the difficulty on this occasion is to determine what ought to be considered as the properest guides."

All through the Discourses there are other remarks equally to the point, but none elucidating the theory of originality in a simpler way. To the foregoing can be added a saying of Coleridge's, namely:—"To admire on principle is the only way to imitate without loss of originality."

If we make a careful survey of English architecture during the past three centuries—apart from the question of revivals of dissimilar styles—we find an amazing variety of forms not only in the development of composition, but in the attainment of original types of buildings. The best of the foregoing structures owe their inspiration entirely to the tradition which preceded them, plus a fusion with imported forms of antique classic, as well as an honest regard for the conditions of the period that witnessed their erection. Turning to the Gothic Revival of the last century, we find that the best works are indubitably those which in spirit closely approach the masterpieces of the Middle Ages; for examples, the buildings of Pugin, Pearson, and Bodley attain to an excellence comparable to old work. Yet when the influence of the Revival waned, and when the passion had almost exhausted itself, the rank and file of the Gothicists sought to express their taste in a style of free Gothic which in its vagaries is almost banal.

On the classic side the originality of Vanbrugh's work has nothing in common with the polished manner we associate with Chambers. Neither would it be just to compare the exquisite finish of Cockerell's detail with the frenzied attempts of modern classic. We might be tempted to say with Gwilt:—"All sense in the application of appropriate forms in mouldings seems now extinct, and Palladio set at defiance. He who can in the present day produce the newest and most extraordinary moulding in profiling an Order is the greatest genius."

An examination of the best modern architecture evolved to-day in America and France proves conclusively that the only original buildings in those countries are those which, in spirit at least, conform to traditional truths.

Publicity for Engineering Work

WIDER use of engineers in public service and the employment of well-recognized means of securing publicity for engineering work of a public nature were two points receiving special emphasis in a paper entitled "Some Factors in Municipal Engineering," read before the American Society of Mechanical Engineers in New York last week by Morris L. Cooke, director of the Department of Public Works, Philadelphia. In addition to these points Mr. Cooke discussed the need for expert advice in municipal work; the unfortunate restriction upon engineers in making expenditures, giving them no contingent fund for emergencies and research work; the absence of a financial program based on a consideration of the needs of the city over a considerable period; the impossibility of securing competent department heads through the generally accepted Civil-Service rules, and, finally, the advisability of establishing a municipal reference library, in which might be deposited copies of engineering reports that do not find their way into print, as well as copies of all printed documents of value to the municipal engineer. The following extracts from Mr. Cooke's paper, for which we are indebted to the Engineering Record, relate, however, only to the availability of engineers for public service and the value of publicity:

Role of the Engineer

The role which the engineer is to play in the development of our municipalities will depend primarily upon the attitude taken by the profession as a whole toward what appears to be a wonderful present opportunity and also upon the ability with which the work of the engineer is brought to the attention of the public. There is no real reason why municipal engineering should not be made to comprise most municipal undertakings.

The test by which the role of the engineer is to be determined will be the development in our profession of a genuine spirit of public service. The community is apparently ready to accord the engineer a leading, perhaps a controlling part, if the engineer will consider that in every decision and act there shall be the clearest possible recognition of the public interest.

There are certain kinds of engineering in which financial and almost all other kinds of preferment depend on an attitude of mind which, while not necessarily anti-social does not provide sufficient opportunity for entertaining a virile public point of view. As a representative of public, rather than private interest, it is my duty in choosing the advisers of the city which I have the honor of serving to satisfy myself not only as to the ability of those we employ, but also as to their disinterested—yes, their public point of view.

Lack of Qualified Men

Judged by this standard, there are in certain fields of engineering almost no engineers who are at present available for the service of the public and who at the same time have had sufficient experience for large undertakings. In the past few years we have had unusual opportunities for seeing at close range the professional attitude of those equipped with the technical knowledge required in advisers to cities on utility matters. It has been practically impossible to secure the services of those with reputations already made in the electrical field. Some of our experiences could be considered on the whole rather amusing were it not for the fact that we are left under the obvious conclusion that for the average city official to get good advice on these matters, is well nigh impossible. What is more objectionable is that this condition is one quite generally recognized as true by city officials. We hear a good deal of complaint on the part of engineers that as a profession we are not chosen more frequently to serve on public service commissions and for similar technical work. Perhaps in our experience may be found at least part of the reason for this condition. Of course when a city wants advice on a subject such as this the matter is usually one of considerable importance, often involving large sums of money, and in reaching conclusions the city official should not be dependent for advice on junior members of the profession.

The same tendency is to be noted in other branches of our profession. An eminent authority on concrete, who is in intimate touch with the men who are practising in this line, was recently asked for the name of an engineer who was not in any way affiliated with the large manufacturers of this material and after considerable study was able to think of only one man. There is nothing necessarily improper in this situation —it may simply mean that all the competent men in this line receive retainers from manufacturers. Some months ago I wanted to retain an engineer fully posted on the details of a certain sub-division of railroad operation. It was extremely difficult to find a man without recognized affiliations which would preclude his retention. Again I am informed that there are no asphalt experts who do not receive retainers from the manufacturers. It is a condition which should be provocative of thought by engineers.

I would not have you think that I do not fully appreciate that our present situation is the natural outgrowth of the fact that all of the foremost engineers have become prominent through the service of private interests. Public employers up to the present have been almost a negligible factor in furnishing opportunity for employment or for the making of a reputation. It is perfectly natural, and it is in accord with former ideals, that engineers should feel their first duty to be to these private employers. But in this time of broader and deeper social consciousness it seems to me that this standard must change.

Magnitude of Opportunity

In inviting the attention of our profession to the municipal field, we are apparently opening the door of opportunity to tens of millions of dollars' worth of work which is not now either considered engineering nor carried on by engineers. The municipal field is almost virgin soil so far as engineering is concerned. As recently as ten years ago the problem of snow removal which is being discussed as a part of this day's program, was so absolutely in the hands of thumb rule, and in many instances even of inexperienced men, that it is probably true that in no city in this country was it being attacked either by engineering methods or by engineers. Yet it will not be denied that on work of this kind, in which one city spent nearly $3,000,000 in six weeks last year, there is in reality an engineering problem of considerable magnitude.

If this municipal field is to be one in which engineers of ability, sincerity of purpose and high ideals are to find a permanent and satisfactory outlet for their energies, our profession acting as a profession will be one of the main agencies bringing about certain fundamental changes in the attitude of the public. In the minds of too many engineers, participating collectively in matters pertaining to municipal engineering means "getting into politics." Architectural work being a part of the business of the Department of Public Works in Philadelphia, we have had the co-operation of the American Institute of Architects and of its Philadelphia chapter from the beginning. We have made many demands on them and in every case have met with generous enthusiastic response. This assistance has been entirely apart from the help rendered us by individual architects. We have had the constant, indefatigable and valuable support of the secretary of the American Society of Mechanical Engineers in our efforts to maintain the highest professional standards in the work of the department. But engineering bodies as such have given us no assistance and, so far as I know, have taken no part in the discussion of federal, state and municipal engineering, except in the matter of conservation, which for some reason is considered as innocuous from an engineering standpoint as a prayer-meeting.

Publicity

I am not one of those who feel that all our shortcomings are "the fault of the people." I would rather assume my share of the responsibility for conditions as they are and then join with my professional associates and the community at large in bettering them. If we engineers are to have any prominent part in this there are fundamental changes which we shall have to make in our own equipment for the work. In the first place, we have to get rid of the now old-fashioned idea that advertising is a crime. I admit that as a part of my work as a public official I put in a great deal of thought on what may be quite properly called advertising. By that I mean that I pay less attention in my reports to dignity of form and diction than to making them sufficiently interesting to be read. It is only as we engineers who are public officials learn to make the public, sometimes against its will, understand our work, that we are to get that degree of popular support for it which will make it possible for it to be done in an efficient manner.

In my opinion it is going to become more and more a necessity, not only in public but in private work, for engineers to be able to popularize what they are doing. It is true to-day that a man who wants to do really good and efficient work can do so only after an aroused public opinion. You cannot drive people in a democracy. So I admit that in offering employment to an engineer, other things being equal, I want what might be called a good advertiser. You can secure appropriations for work more easily when it is well advertised. The Panama Canal is a good example of this principle. Again, advertising is the best possible check against ill advised expenditures. In building our Byberry and Bensalem service-test roadway we erected sign-boards on each of the 26 sections giving to the layman the exact method of its construction in non-technical language. If the public know how a street is supposed to be constructed or cleaned, you do not require as many paid inspectors on the job.

Development of Public Opinion

The development of some varieties of municipal engineering is absolutely dependent upon the development of public opinion and must proceed with it. The matter of street cleaning is largely a question of an improved public taste in the matter of street paving. Unless streets are well paved they cannot be well cleaned except at a prohibitive cost. To jump from one degree of cleanliness in this respect to another without a supporting public opinion may be enough to wreck an administration and to set the tide of civic improvement running in the opposite direction.

The newspaper is the great educator in these matters to-day. But we are already using in Philadelphia moving pictures, parades and exhibitions. The possibilities of these and other means of publicity are not yet fully understood.

Again, more effort must be put into humanizing public administration. The engineer shares with those who have had the opportunity for education, the mistaken idea that the man at the top is in a position to tell the man at the bottom what is good for him. The fact that our country was founded and has been perpetuated on the contrary idea has not seemed to affect the situation very much.

Take, for instance, the movement which has led to the formation of large numbers of business men's associations and improvement associations. I have found these associations ready and anxious to hear from men who had definite knowledge on matters of public interest. It should be the attitude of any engineer to affiliate with one of these organizations and to help to make it an influence.

Floors for Steel Highway Bridges[*]

By Clifford Older, A. M. Soc. C. E.[†]

DEFINITE statistics in regard to the number and length of highway bridges for any considerable mileage of highways are difficult to obtain and are not at present available. In some states, however, we are able to ascertain the amount of the total expenditure for bridge-work of all kinds. Available information of this kind seems to indicate that approximately one-half of the funds raised for ordinary road and bridge purposes are expended in the renewal and maintenance.

It is evident, therefore, that if maintenance expenditures are to be reduced to the minimum, highway bridges and bridge floors must receive careful consideration.

Judging from conditions in Illinois, it is probable that at least 90 per cent. of all existing highway bridges are provided with nothing better than plank floors, and that the maintenance of these floors costs approximately 15 per cent. of the total expenditure for road and bridge maintenance, or about $10.00 per mile of road per annum.

Floors for New Bridges

It is a simple matter to provide sufficient strength in the design of a new bridge, to accommodate any of the various modern types of floors or wearing surfaces.

It seems desirable to select a type of floor which will permit the use of a wearing surface of the same kind as that on the adjacent highway, so that the same method of maintenance may be used on the bridge floor elsewhere.

The difference in weight of various types of floors has little effect on the design and cost of concrete bridges. Steel bridges, however, are materially affected in both design and cost, by a comparatively small variation in the weight of the floor. The saving in the weight and cost of the steel in the trusses and floor system for the lighter floors may outweigh the advantage of having the same wearing surface on the bridge as elsewhere on the highway. Floors for steel bridges only will be considered in this discussion.

It is desirable to provide an independent wearing surface so that although the pavement may be worn practically through, the bridge may still carry traffic with safety. The bridge floor should then preferably consist of two elements: the sub-floor, which should be as permanent as the bridge superstructure and should provide the necessary strength to transmit the highway loads to the floor supports, and a wearing surface of such character as to permit of economical maintenance.

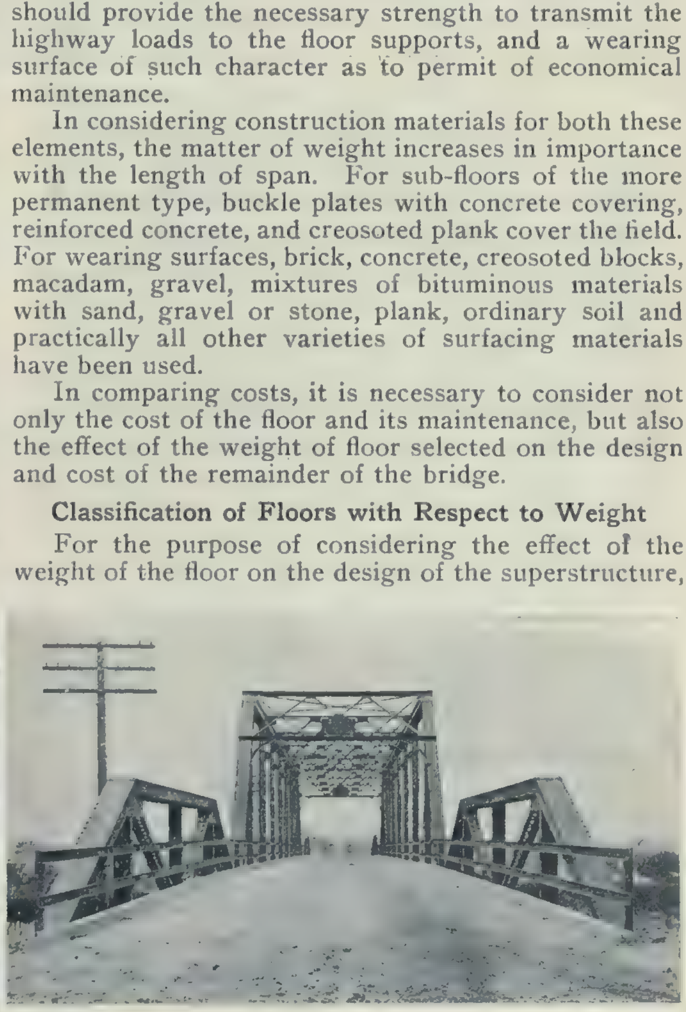
In considering construction materials for both these elements, the matter of weight increases in importance with the length of span. For sub-floors of the more permanent type, buckle plates with concrete covering, reinforced concrete, and creosoted plank cover the field. For wearing surfaces, brick, concrete, creosoted blocks, macadam, gravel, mixtures of bituminous materials with sand, gravel or stone, plank, ordinary soil and practically all other varieties of surfacing materials have been used.

In comparing costs, it is necessary to consider not only the cost of the floor and its maintenance, but also the effect of the weight of floor selected on the design and cost of the remainder of the bridge.

Classification of Floors with Respect to Weight

For the purpose of considering the effect of the weight of the floor on the design of the superstructure,

Concrete sub-floor ready for wearing surface.



Concrete sub-floor—macadam wearing surface.

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[*] Paper presented at the Annual Convention of the American Road Builders' Association held last week in Chicago.

[†] Bridge Engineer, Illinois Highway Department.

Creosoted plank sub-floor—brick wearing surface.

the various types of floors are herein grouped in four classes.

Class A Floors.—Floors which weigh approximately 100 lbs. per sq. ft. of roadway surface are included in Class A. Floors consisting of a reinforced concrete sub-floor, assumed to weigh 50 lbs. per square foot, on which is placed a wearing surface of concrete, brick, macadam or gravel, are of this class. The wearing surface is assumed also to weigh fifty lbs. per sq. ft. of roadway surface.

Class B Floors.—Floors which weigh approximately 65 lbs. per sq. ft. of roadway surface are included in Class B. Floors consisting of a concrete sub-floor, with a creosoted block wearing surface and floors consisting of creosoted plank sub-floors with a brick wearing surface, are of this class.

Class C Floors.—Floors which weigh approximately 32 lbs. per sq. ft. are included in Class C. Floors consisting of a creosoted plank sub-floor with a creosoted block wearing surface, are included in this class.

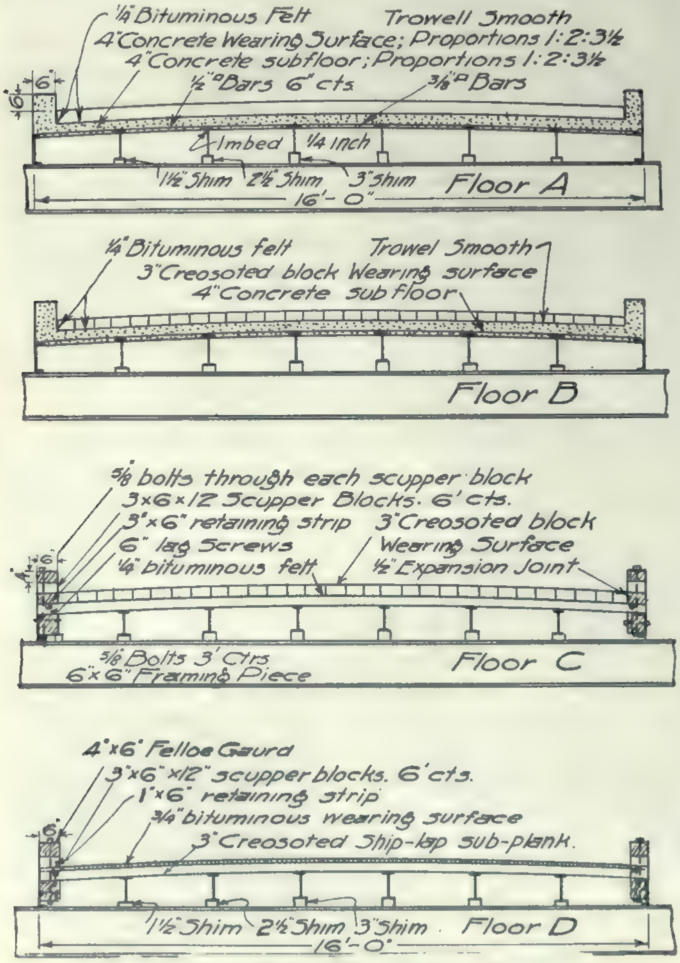


Fig. 1.—Standard designs, Illinois Highway Department.

Class D Floors.—Floors which weigh approximately 26 lbs. per sq. ft. are included in Class D. Floors consisting of a creosoted plank sub-floor with a wearing surface about three-fourths of an inch thick, composed of a mixture of gravel and bituminous material, are of this class.

Buckle plate floors are not considered, as they weigh as much and cost more than concrete sub-floors.

Description of Floors Illustrated

Fig. 1 shows standard designs used by the Illinois Highway Department for the floors above mentioned. The creosoted plank sub-floors (Floor C and Floor D) are crowned by bending the plank over the stringers and anchoring the ends to the nailers by means of lag screws. The creosoted blocks (Floor B and Floor D) are laid on a ¼-inch bituminous felt cushion, which is coated with asphalt immediately before laying the blocks. Shiplap sub-plank are used for floors having a bituminous gravel wearing surface. The use of this form of sub-plank has been found to be the cheapest and most effective method of preventing the leakage of the bituminous material.

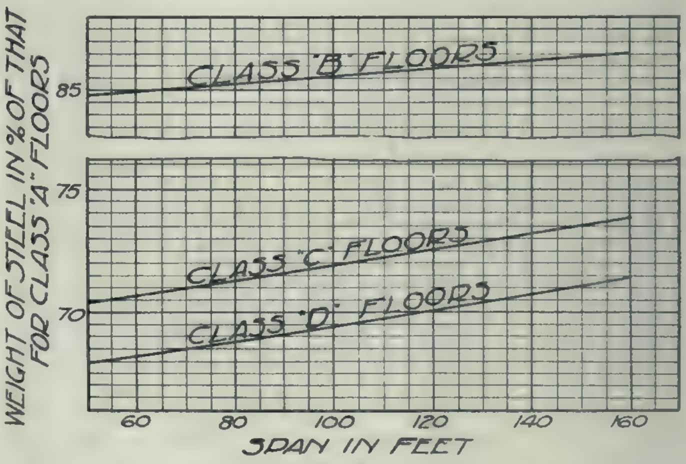


Fig. 2

Explanation of Curves

The curves (Fig. 2) show the weight of the structural steel in bridge superstructures as a per cent. of the weight of the steel in superstructures having Class A floors. That is the weight of superstructure steel in bridges having floors weighing 100 lbs. per sq. ft. is taken as 100 per cent., and the weight of steel required for the lighter floors expressed as a percentage of this weight.

These curves are based on the weight of steel in spans which conform to the standard designs of the Illinois Highway Department. The designs used provide for 16-foot roadways. The curves were checked at a number of points, however, for 18-foot roadway designs and were found to conform very closely. These curves are sufficiently accurate to enable a designer to determine the relative cost of steel superstructure having floors of various types and weights.

The curve (Fig. 3) is based on the curves (Fig. 2) and shows the average per cent. variation in weight of steel for a variation of ten lbs. per sq. ft. in the weight of the floor.

Fig. 4 shows the average contract price for the Illinois Highway Department standard 16-foot roadway steel spans with floor complete.

For spans up to 80 feet inclusive, rivetted pony trusses are used. For spans from 90 to 160 feet, rivetted Pratt trusses are used. This range of span length covers at least 90 per cent. of the highway bridges in Illinois.

The average contract price of materials is as follows:—structural steel complete in place, $.03½ per lb.; concrete sub-floors, including reinforcing steel, $12.00 per cu. yd.; concrete wearing surface, 4 inches think, 90c. per sq. yd.; creosoted sub-plank (12-lb. treatment) complete in place, $70.00 per thousand feet board measure; creosoted block wearing surface, $1.80 per sq. yd.; bituminous gravel wearing surface, 60c. per sq. yd.

The average cost of sub-floor and wearing surface per foot of 16 feet wide roadway (1.78 sq. yds. including curbs) is as follows:—concrete sub-floor with concrete, wearing surface (weight 100 lbs. per sq. ft.) $4.25 per ft. of bridge; concrete sub-floor with creosoted block wearing surface (weight 65 lbs. per sq. ft.), $5.80 per ft.; creosoted plank sub-floor with creosoted block wearing surface (weight 32 lbs. per sq. ft.), $7.30 per ft.; creosoted plank sub-floor with bituminous gravel wearing surface (weight 26 lbs. per sq. ft.), $5.15 per ft.

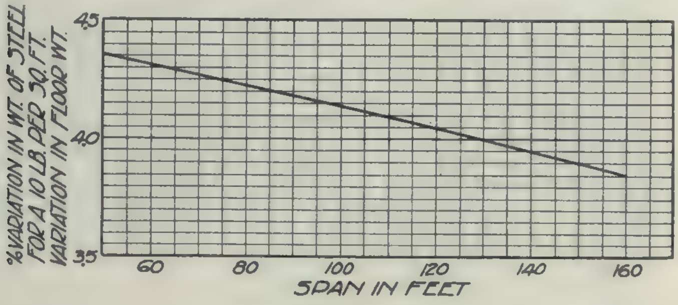


Fig. 3

It seems probable that under average conditions the length of life of the floors represented by the upper three full line curves may equal that of the remainder of the superstructure and that the cost of maintenance for this period would be small.

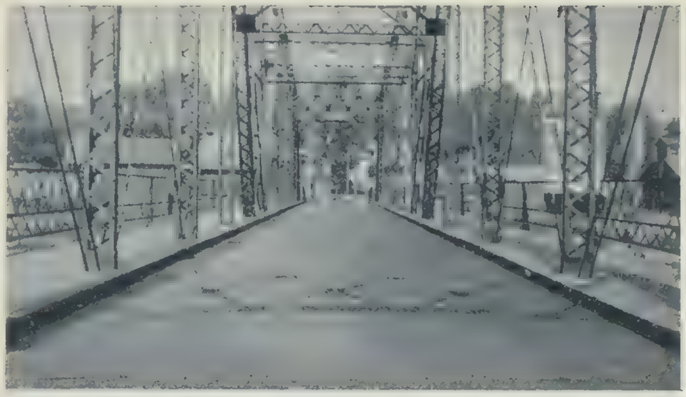
The experience of the Illinois Highway Department seems to indicate that under average conditions the bituminous wearing surface requires a light treatment of oil and stone chips or screened gravel, at intervals of about four years at a cost of about ten cents per square yard and a probable complete resurfacing once in about twelve years at a cost of approximately 60c. per square yard. This amounts to 7½c. per square yard, per annum. Adding to the first cost of the bridge, the maintenance charge capitalized at 6 per cent., Curve D, Fig.4 results. The position of this curve indicates that it would be preferable to use creosoted block or other floor in building new structures

Probably 95 per cent. of existing steel highway bridges were originally designed for ordinary plank floors. Under average conditions and at the present price of yellow pine, which is the material now quite generally used, the annual cost of maintaining such floors is about 35c. per square yard. The first cost, plus the maintenance charge capitalized at 6 per cent. results in curve E, Fig. 4.

Conclusions

It is evident that ordinary plank floors having an average life of not more than three and one-half years are to be avoided when possible.

It is to be noted that with the exception of the floor with the bituminous surface, the cost of the floor increases as the weight decreases, and yet the cost of the entire superstructure decreases as the weight of floor decreases.



Creosoted plank sub-floor.

The saving in cost for the lighter floors increases with an increase in the unit cost of structural steel in place, and decreases with an increase in the cost of the materials used in such floors.

In reflooring old steel bridges of satisfactory design, a creosoted sub-plank with bituminous wearing surface has been found to give reasonable service. The weight is somewhat greater than that of a plank floor, but the effect of the added weight is probably offset by the reduction of impact, due to the comparatively smooth and wielding surface.

The cost of maintaining the bituminous surface is only about 20 per cent. of that of an ordinary plank floor.

There seems to be no place in the economic design of new highway bridges for floors consisting of a creo-

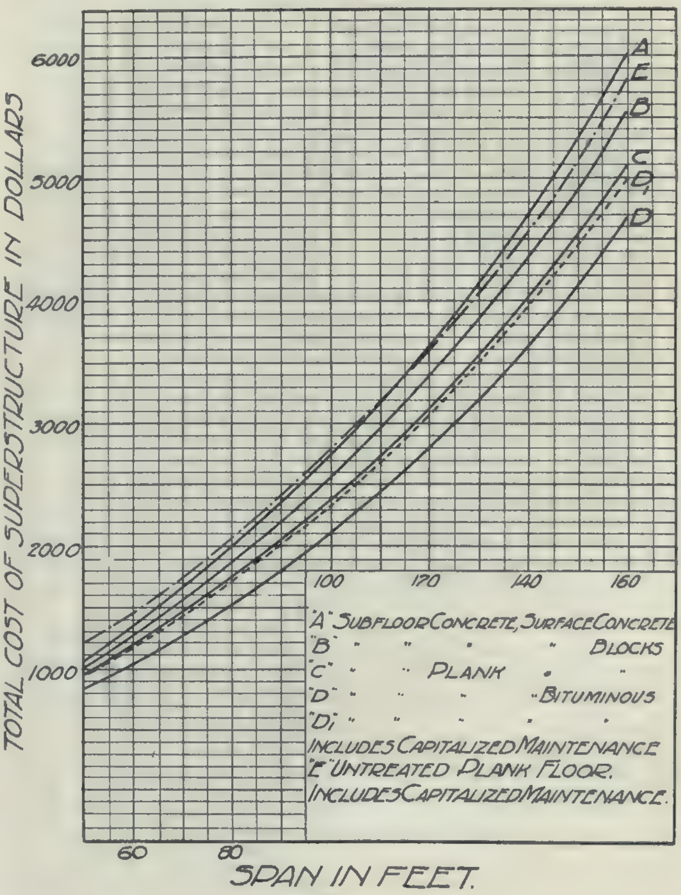


Fig.

soted plank sub-floor with a brick wearing surface, as the life of such a floor could hardly be greater than that of floor C, Fig. 1, while the cost of the complete superstructure would be greater than that represented by curves B and C, Fig. 4.

The floors listed under Class A seem hardly to be justifiable, except for short spans, unless other considerations outweigh first cost.

The Selection of Road Machinery*

By T. R. Agg†

THE wide range of machinery and appliances available for road and pavement construction makes advisable a careful selection for any particular class of work, and yet many types of machinery are so much alike in general design that a selection must be based on a careful study of their operating characteristics. Probably there is no one best type as a general rule. It is not within the scope of this paper to discuss the many kinds and varieties of good, bad and indifferent road building machinery, but it is proposed to discuss a few principles applicable to its selection, operation and maintenance.

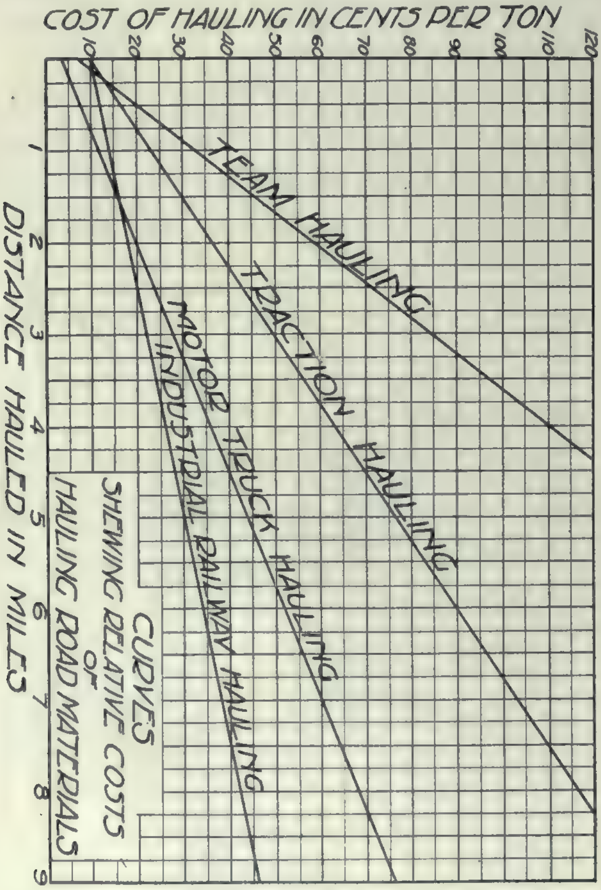


Fig. 1

We find a group of machines available for earth road work, another for macadam construction, and so on through the various classes. These groups overlap to some extent.

Of the machinery offered for earth work certain types, such as the leveller, are for a rather limited kind of work, while others, such as the blade grader and elevating grader, are for more diverse uses. When a selection is to be made for a special work for which only one class of machine is made, one has only to choose the best bargains from the limited offerings of the class. But when machinery is to be chosen for more diverse uses operating characteristics and adaptability must be considered. It will usually be found that the selection may be narrowed down to two or three makes and the final choice will depend upon price and personal preference.

The leveller has already been mentioned as an example of a specialized machine, and the mixer for concrete pavement construction is another. For this work it seems to be agreed that the traction type with boom delivery is the best. Of these, several makes are available and which to select will depend upon the purchaser's opinion as to the value and suitability of individual machines.

On the other hand, the choice for earth road construction will be between the elevating grader and the blade grader, and between traction haulage and team haulage, and between the steam tractor and the gas tractor. Here the purchaser must decide between the classes first of all, and then between individual makes of the class.

This is typical of the machinery available for many classes of road work and the basis for a proper comparison is not easy to state. It is believed, however, that the following factors must be taken into account: (a) purchase price, (b) rate of depreciation, (c) maintenance cost, (d) cost of operation, (e) speed, all of which enter into the cost of doing work with any piece of machinery.

To properly estimate these factors there is at present but incomplete and contradictory cost data available and engineers and contractors can do a great service by giving publicity to any reliable and conclusive cost data that comes into their hands.

Purchase Price.—Some kinds of machinery will save their cost in a comparatively short time and such may unhesitatingly be chosen because the user can readily foretell whether he has enough work ahead to make the investment profitable. Other kinds require a large outlay and must be used with reasonable regularity for a term of years before they will prove profitable. Eventually, if they can be kept busy they will pay out, but before such machinery is purchased there must be some assurance that the necessary work can be secured. It would often be cheaper in the long run to use a machine which operated at higher unit costs, but which could be purchased at a much lower price.

Depreciation.—Depreciation is probably the most difficult factor to estimate, because the carefulness of the operator has such a marked influence on the life of a machine. With most machinery the average life is fairly well established and hence depreciation can easily be estimated. This is a very important cost item and is probably more often placed too low rather than too high.

Maintenance.—The influence of maintenance on unit cost is well understood and needs no especial comment. Probably this item is also more often underestimated than overestimated. It should be borne in mind that maintenance cost really includes not only the charge for making repairs to a machine but also the cost of delay due to the idle time of the machine.

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* Paper presented at the Annual Convention of the American Road Builders' Association held last week in Chicago.

† Professor of Highway Engineering in the Iowa State College.

When a large gang is working around a machine such as a concrete mixer, any delay on account of the machine is expensive.

Cost of Operation.—The cost of operation for a machine should be taken from the average of many runs under normal conditions and not from exceptional runs made under the most favorable conditions. Quite often this average will be double that which is occasionally obtained when all conditions are favorable. This cost will include the pay of all men needed to run the machine and the cost of all supplies regularly used in its operation.

Speed.—The rapidity with which a machine performs its work is a very important consideration not only from the standpoint of cost per unit of work done but from the impetus it gives to the entire job. This is particularly true in road and pavement construction where favorable weather conditions must be utilized.

Skill Required to Operate.—The skill required to operate a particular machine should be given consideration, because expert operators are not always easily obtained and if a machine requires considerable skill in operation to produce the maximum output, its average may be low due to the difficulty of securing and retaining expert operators. Such machinery should usually be purchased only because of its marked superiority in other respects.

Adaptability.—Adaptability of a machine to various classes of work is an important consideration because it is rarely possible to foretell just where it will be used next, and it is better to use a reasonably efficient machine continuously than it is to use a special and highly efficient machine for a certain kind of work and have it idle a large percentage of the time.

Having estimated as accurately as possible the various factors enumerated as above, preference should be given to the one type showing up the best.

The adoption of certain types of machinery for various classes of road work has been largely a survival of the fittest, although on account of the new types that are continually being marketed, the process of weeding out is going on constantly. For most classes of highway work the preferred types are fairly well known and to enumerate them here would serve no useful purpose.

In rural communities labor is usually scarce, and the contractor in highway construction will find it to his advantage to utilize every machine that will facilitate his work even though it may not in all cases reduce his unit costs. In the long run he will profit because of a greatly increased yardage for his season's output.

Those engaged in constructing roads and pavements have long realized what a large item of cost is incurred in hauling materials and some discussion of the methods available is pertinent to this paper. Many factors involved in determining the cost of hauling are variable for work in different localities but for a given piece of work the amount of each of these can usually be selected with reasonable accuracy, and the economy of various methods thus compared.

The cost of hauling varies with the following factors: (1) length of haul; (2) rate of travel of the outfit used; (3) amount of time lost at cars while loading and at road while unloading; (4) amount of time lost on account of bad roads; (5) capacity of the outfit per trip; (6) cost of operation of the outfit.

Length of Haul.—Length of haul for a given piece of work is, of course, the same no matter what method of hauling is used.

Rate of Travel.—The rate of travel varies somewhat between outfits of the same kind, and yet there is a value that is reasonably near an average for all outfits of a type. For teams two and one-half miles per hour, traction outfits three miles per hour, motor trucks ten miles per hour, and for the industrial railway ten miles per hour may be taken as typical speeds, assuming half the distance is travelled empty and half loaded.

Lost Time.—The amount of time lost at cars depends upon the method of loading the outfit. If hand shovelling is resorted to, the time will be relatively long, but extra units of the outfit may be loaded while the others are on the road. This is advisable for all classes of hauling outfits and is a necessity in traction hauling and with the industrial railway. Bins at the sidings with capacity for a full load for the outfit may be used instead of extra units of equipment and are a necessity when the motor truck is used. For team hauling the loading chute may be employed instead of extra wagons. In any case time lost at the cars is expensive, especially on short hauls, and should be eliminated as far as possible.

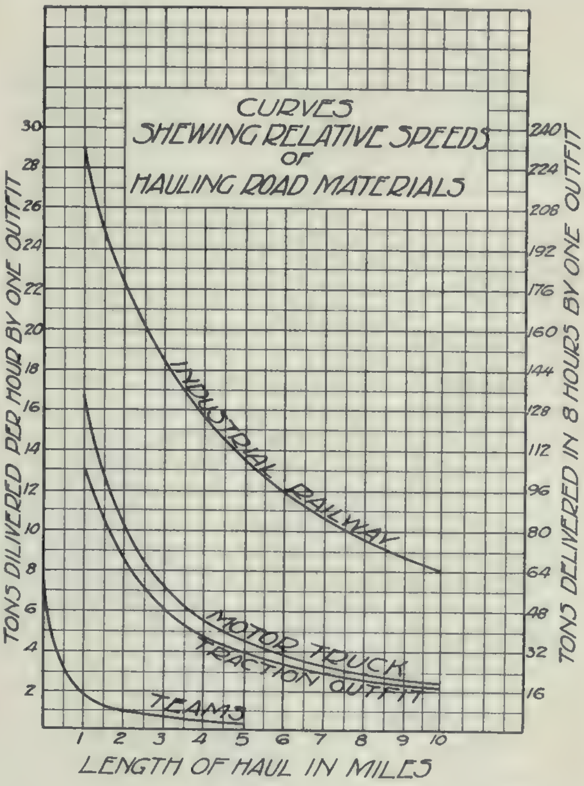

Fig. 2

Records of loss of time in loading and in unloading are exceedingly diverse but the following amounts lost per trip are near enough the average to give comparable results: with team hauling 18 minutes, motor trucks (loaded from bins or hoppers) 6 minutes, traction outfits, 30 minutes, and with the industrial railway, 30 minutes.

Time lost due to the condition of the road cannot be evaluated in a discussion like this because it varies throughout the season, differs with the locality and with the kinds of roads over which the hauling must be done. It is greatest with the traction outfit, is about the same for team and motor truck hauling, and is a negligible factor for the industrial railway.

The capacities of these outfits per trip are also exceedingly diverse and perhaps no particular one is typical, but equipment of the following capacities is in common use.

Wagons for team hauling two tons, motor trucks five tons, traction outfits fifteen tons, industrial railway trains twenty tons.

The cost of operation of each of these outfits will vary with the skill of the superintendent, the character of the operator, the kind of weather encountered, and the nature of the road that is used. Cost of operation should include the following items: interest on investment, depreciation on outfit, maintenance of outfit, fuel, oil and other supplies used and labor cost of operation.

These various items must be evaluated in estimating the cost per hour for operation, and a careful study of the subject has led to the assignment of the following values. If any inequalities exist here it will of course change the entire relation, but the method of comparing costs of hauling as outlined is applicable and that is the principal object of this discussion. Cost of operation per hour for teams $0.50, for motor truck $2.00, for traction outfit $3.00, for industrial railway $400.

Knowing the relation that exists between these various factors that enter into cost of hauling, an equation may be written to show the cost per ton which is as follows:—

$$C = \frac{rd}{us} + \frac{Tr}{u}$$

where

$C =$ cost per ton for a length of haul $= \frac{d}{2}$

$d =$ distance in miles travelled per round trip.

$u =$ number of tons hauled per trip.

$s =$ speed of vehicle in miles per hour.

$T =$ time lost loading plus time lost unloading.

$r =$ cost of operation in dollars per hour.

If, in the general expression given above, we insert the values of the various factors for each method of hauling, we get the unit cost of hauling by that method for any length of haul $\frac{d}{2}$. These are as follows:

$C = 0.1\,d + 0.075$, for team hauling.

$C = 0.04\,d + 0.04$, for motor truck hauling.

$C = 0.066\,d + 0.10$, for traction hauling.

$C = 0.02\,d + 0.10$, for industrial railway hauling.

For convenience of comparison the unit costs for various lengths of haul have been computed and the diagrams in Fig. 1 constructed. It is easy to see at a glance the most economical method for any length of haul. If the assumed values of the various factors are in any case inapplicable to a given set of conditions, the proper ones may be selected and similar curves drawn for use in comparing the costs for those conditions.

It is also convenient to know the capacity of these various outfits per working day and the diagrams in Fig. 2 have been drawn to show the amount of material each outfit will deliver per hour and per day when working under the assumed conditions.

The important thing in this discussion is not the relative costs shown by these diagrams but the possibility of reducing to definite data the probable costs for any piece of work, thus obtaining a basis for determining which method to use.

In all of this discussion one factor has of necessity been omitted which is of greater importance than any other, and that is the personality of the superintendent. One man fails to make certain equipment pay out and another succeeds in accomplishing remarkable results with it. Two sets of cost data are obtained, the one showing abnormally high costs, the other showing costs that are exceedingly low. No general discussion can ignore these facts but they cannot be put into data for use in average cases.

Instruction to Engineers

States, municipalities and a few construction companies seek to insure that no engineer in their employ will allow the organization of which he is superintendent to fall below the average in efficiency. To that end instructions regarding the use and capacity of various kinds of machinery and as to methods of organization are furnished. Some of these manuals of instruction are excellent treatises on highway construction. Three phases of the use of machinery are usually presented and these cover the normal requirements of such instruction.

The general organization of the work is first outlined. Ordinarily some one machine or operation is the pace maker for the whole job and when that is true the engineer in charge of construction must build up his whole organization about that machine or operation. The instructions can outline a workable organization, but the live engineer will usually be able to improve upon the details.

The instructions next deal with the capacities of machines, rate of construction that can be attained, and quality of work that should result. Such matter serves admirably as a yard stick by which the engineer may measure his efficiency. Here again, a man's personality will often enable him to do much better than the average set down in the instructions.

And finally the instructions deal with reports, cost data and records of progress that are required. In this respect the instructions will be specific and lay down exact requirements.

Instructions to engineers are not, nor can they be, a series of exact rules that must be followed because no one can foresee all phases of the multitude of detail that enters into the prosecution of construction work, and competent engineers would be hampered by instructions that attempted to prescribe exactly how each machine should be utilized.

Instruction to Operators

In the widespread use of costly machinery there always lies the danger of loss through incompetent operation. Delays due to breakdowns are costly and often avoidable. Here again many states and municipal organizations seek to avoid trouble by furnishing to machine operators complete instructions.

These instructions deal first of all with the operation of the machine and since the work is largely mechanical though skilled, the instructions can say in detail just how the machine is to be handled. Here minute instructions are justifiable and they should include besides suggestions on operations, others on the care of the machine, the making of repairs, methods for adjustments and renewals of working parts.

The matter of personal conduct should also be dealt with in these instructions since the public often obtains its impressions of a department by the conduct of some irresponsible subordinate.

The construction of highways involves the handling of much bulky material, and consideration of efficiency and economy requires that the machinery shall be well adapted to the work for which it is used, that the operation be systematized so that each machine will produce to capacity, that the machinery shall be handled in an intelligent manner so as to have normal life, and that the problem of transportation be studied in all its relations before a system is adopted.

Water-Works Service Pipes

No problem in water-works operation, apparently, is of greater interest to water-works officials generally than the selection of the kind of service pipe and the method of connecting mains and services. Some points brought out in the discussion of these subjects at the November meeting of the New England Water Works Association are given by Engineering News.

Brookline Practice—F. F. Forbes, superintendent of the water-works of Brookline, Mass., cited 40 years' experience with cement-lined wrought-iron pipe with no record of trouble from corrosion on straight services, but about 30 instances of corrosion at the curb cock connections.

His department has always used a lead goose-neck connection at the main to allow for settlement in the service pipe or main, which is always liable to follow disturbance of the street for sub-surface construction. These goose-necks save many leaks, for several instances have been found where the goose-necks had been straightened out by settlement of the pipe yet the connection remained intact.

Service pipes are laid at a depth of 5½ ft. and no trouble is ever experienced with frozen pipes.

Some lead service pipes are used, but difficulty has been found in getting pipe to stand the high pressure used in Brookline.

In getting around subsurface obstructions, it has been found easy to bend cement-lined service pipe to as short as a 10-ft. radius without damage to the cement lining.

The pipe couplings are lined with cement while fastened to one end of a length of pipe, and the cement lining is afterwards dug out of the thread to insert the added length. The F. O. Norton brand of natural (Rosendale) cement is used, as ordinary Portland cement is found to be lacking in elasticity.

The pipe fittings are galvanized-iron. Corrosion of the exterior of the pipe just inside the cellar wall is the commonest source of trouble. In such places and in locations subject to alternate wetting and drying the water department now uses galvanized iron pipe, cement lined.

Marlborough Experience—Geo. A. Stacey, superintendent of the water-works of Marlborough, Mass., said that two cases of lead poisoning through the use of lead pipe for well water, in the early days of the city's water-works, resulted in such a popular prejudice against lead pipe that cement-lined wrought-iron pipe was subsequently adopted for all service connections. Cement-lined iron pipe was used for eight or ten years, but much trouble was experienced by rusting out at joints. Accordingly, about 15 years ago, the water department quietly returned to the use of lead pipe, and it has been used ever since without the least suspicion of lead poisoning.

Holyoke Experience—Patrick Gear, superintendent of water-works, of Holyoke, Mass., stated that ordinary iron service pipes had been in use for 40 years in Holyoke. No goose-necks are now used for connections at mains, owing to the difficulty in cleaning the service pipes. At present, galvanized-iron and lead-lined iron pipe are being used.

CONCLUSIONS

Instances were cited of long life in galvanized-iron service pipe, but these were exceptions rather than the rule.

An objection was raised to any kind of iron pipe because of the expansion and contraction, which leads to breaks at the curb cock; but this objection is largely overcome by the use of lead goose-neck connections. On the other hand, the objection to a goose-neck connection is the impossibility of cleaning the entire service from house to main. This has led to taking out all goosenecks in Holyoke, wherever new services are placed or renewals are made.

There is a need and a market for some kind of cheap expansion joint for use at curb cock connections, and a need for an effective small pipe-cleaning apparatus.

Difficulties with cement-lined service pipe are chiefly corrosion at joints and want of elasticity. The couplings must be cement-lined, or in some instances rubberoid and tar have been used successfully for lining. Sometimes lead couplings are used. Cement-lined pipe must always be sawed in two and not cut in a pipe-cutting machine, which destroys the lining in the vicinity of the cut.

Lead service pipe is the prime favorite of water-works men generally because of its freedom from corrosion, expansion and contraction troubles, and the ease with which it is bent and cut to fit any location.

Lead pipe should never be used, of course, where there is any chance of lead poisoning, but this is believed to be rare. Robert S. Weston, consulting engineer, of Boston, Mass., pointed out the extreme difficulty in determining by laboratory tests certainty as to whether water would or would not permanently affect lead pipe. Acid swamp waters are particularly dangerous.

The only real grade in many cases is experience; if lead pipe becomes coated on the interior, it is probably safe to use, but any lead pipe which retains a bright interior surface after extended use is almost sure proof that the water conducted through it has dissolved lead and is dangerous. Much popular prejudice against lead pipe is founded on sentiment rather than real reason, was the general opinion.

In many cities public-service corporations place their sub-surface structures in any part of the street they see fit, and as the water main is usually near the middle of the street, the result has often been that these public-service structures have completely blanketed the water main, making straight service pipes impossible. This is a condition to be met by a better organization of city departments and by granting more authority to city officials over public-service corporation construction work.

General Principles of Snow Removal

CITY engineers and other municipal officials may find some interest in the following general conclusions of a special committee appointed to submit a report at a recent conference of street-cleaning officials at Philadelphia. The officials in question represented sixteen cities in Massachusetts, Oregon, and the District of Columbia.

1. The plan of organization and the system to be employed should be worked out in advance of the snow season. The preliminary work should involve: (a) plan of co-operation of all branches of the municipal government; (b) the formation of a skeleton organization composed of all the available city forces, such as engineers, inspectors, time-keepers, laborers and teams; (c) the division of the city into zones and the determination of a definite method of work for each zone. The various members of the organization should be assigned to these zones and the responsible officials familiarized with the duties expected of them.

The character of work to be performed in the different zones may consist of merely the regulation of opening cross-walks and gutters and otherwise generally assisting pedestrian traffic and the run-off of the snow, or it may consist in the complete removal of the snow from the streets. Owing to the general increase in motor traffic and the concentration of business in definite office districts and to the general public demand for increased urban facilities, the present tendency is to increase the scope of the work involving the complete removal of snow from all main thoroughfares and business streets.

2. The work of removal should commence as soon as the snow has covered the pavements and the indications pointing to the storm continuing the operations should be carried on continuously. This as a principle is successfully followed by street railways in the removal of snow from their track space and by some cities.

3. The carrying capacity of the sewer system should be utilized as far as possible to get the snow away from the streets.

The use of the sewers which reduces both the haul and handling to a minimum involves two operations: namely, getting the material to the catch basins or manholes. and then putting the material into the sewers. The first operation can best be done by loading into wagons or trucks and hauling to suitable manholes or by the use of scrapers or graders. The problem of getting the material into the manholes in the least time and with the least interference with traffic opens up a field for consideration of the question ot special forms and special locations of manholes designed to be used solely for this purpose.

The method of flushing the snow with fire hose into catch basins may have a limited application, but it is too unreliable to have any general value, as it depends on weather conditions.

4. When practicable, where there is only a small area to be cleaned, the work should be performed directly by the municipality by day labor. This method of operation is the most flexible and the most easily administered and it obviates the necessity of measurements and checking involved under the contract system. The work can also be performed by day labor in large areas by adopting the following method: The department to advertise and go out into the open market and hire teams to haul the snow for so much per yard, the price to be determined on by the department and to represent a fair estimate of the cost of the work and a fair profit. This, of course, would throw the work open to anyone owning one team, or a hundred or a thousand or more teams, depending upon the amount of work to be performed, and would not leave the department dependent upon any one or more contractors. In this method, as well as when the work must be performed by contract system, a method of measurement as simple and accurate as possible should be used. The practicability of having work done by the municipality will depend among other things on the immediate availability of an appropriation. It is essential for the proper conduct of the work whether by day labor or contract that appropriation for snow removal should be made in advance of necessity for the work.

5. Co-operation should be sought with the traction companies and use made of adjustable plows and sweepers to open roadways adjacent to street railway tracks at the time that the work of clearing the tracks is being carried on.

6. Effort should be made to obtain the co-operation of the public and to instruct the householders in the method of the removal of snow from private premises in such a way as to least impede the city's work. Where sidewalks are of greater width than would be necessary to handle the reduced volume of pedestrian traffic, which may be expected after a heavy snow, the snow instead of being entirely cleared from the sidewalk and piled in the roadway should be left on the sidewalk near the curb line to be removed later by the city when opportunity presents itself.

7. The police force of the city should co-operate with the street cleaning force and the services of patrolmen as inspectors should be utilized as far as possible. The police in particular should give attention to the enforcement of regulations governing the removal of snow from the sidewalks or from a portion thereof.

Tunnel-Boring Records Broken

WORLD'S records for tunnel-boring have been established by Messrs. Foley Bros., Welch & Stewart, contractors on the C. P. R. Rogers Pass tunnel scheme. Last month, states Mr. A. C. Dennis, superintendent of construction for the contractors, 817 feet of the "pioneer" heading—the preliminary shaft running parallel to the main passage, from which operations are directed at several points—was excavated. The American record for a month's tunnel boring was 810 feet, and this feat was accomplished in 31 days, while there were only 30 days last month. The maximum amount of excavation on a tunnel heading for a day was formerly 36 feet, this projection being accomplished on the Simplon tunnel through the Alps. This record was eclipsed one day last month on the tunnel through the Selkirks, when 37 feet was excavated. The world's record was beaten also for a week, 220 feet of rock being bored.

As a result of the rapid progress now being made with the tunnelling operations, the contractors are now confident that they will put the Rogers Pass tunnel through several months earlier than their contract with the Canadian Pacific calls for. The five-mile, double-tracked passage through the base of Mount Macdonald is to be ready, according to the terms of the firm's agreement, by the end of 1916. At the present rate of projection it is estimated that the tunnel will be completed in the summer of 1916.

There remains 16,000 feet of the "pioneer" shaft yet to be driven, 10,640 feet having already been bored.

At the west end of construction, 317 feet of the preliminary shaft, and 640 feet of the main passage was excavated last month. From the eastern portal 527 feet of the former and 588 feet of the latter was projected.

Although the work has been well advanced the hardest part of the actual boring has yet to be done. Mr. Dennis states that the next two miles through the heart of the mountain will have to be dug out of a particularly hard kind of rock.

Characteristics of Materials*

By E. B. Tilt†

SOME time ago it occurred to us that a popular description of the physical characteristics of some of the materials used in the mechanical department of a railway would prove interesting and might lead to a profitable discussion. Not all of us could tell off-hand how to distinguish a piece of iron from a similarly-shaped piece of mild steel, or where we shauld use bronze instead of white metal, or why a piece of high speed steel can be run at a red heat and retain its usefulness. These and many other questions are not of the same importance to us all, but the explanations are interesting. As my experience has been mainly with the materials used in the construction of rolling stock I shall not discuss those required by the Engineering Department, and which include rails, ties, structural steel, masonry, and so on. I shall not discuss devices either, but confine myself strictly to materials and their attributes.

The principal groups of materials brought for railway shops, nearly in their order of value are: (1) iron and steel products; (2) lumber; (3) brasses, bronzes and other alloys; (4) paints; (5) rubber products.

Iron and steel products cover a very large percentage of the cost and construction of an engine or a car and these may be further sub-divided into: (1) STEEL (a) rolled or forged, (b) cast; (2) IRON (a) puddled, (b) cast, (c) malleable.

Consider a locomotive for a moment. The spring plates, firebox and boiler plates, tyres and tubes are made of rolled steel; of forged steel the axles, side rods and crank pins; of cast steel the frames, frame braces and cross heads; of puddled iron the engine bolts and staybolts; of cast iron the stack, bell stand and small fittings; the journal boxes and a few small fittings of malleable iron. If we run over in our mind's eye the materials in a modern steel frame freight car we have cast iron wheels, forged steel axles, rolled steel sills and frames and springs, cast steel couplers and pedestals, malleable iron journal boxes, door locks and stops and minor fittings.

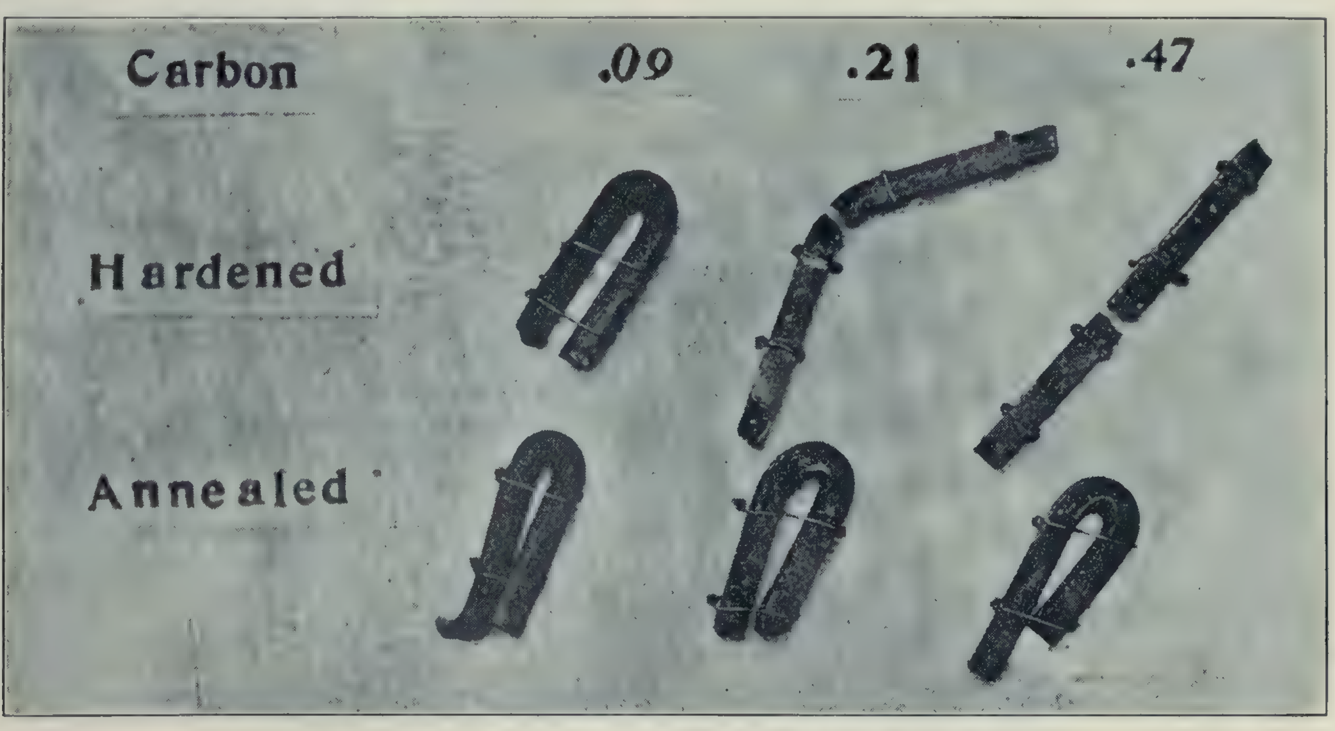

Fig. 1.—An illustration of the effect of various amounts of Carbon on Steel.

A reasonable question is why are so many different qualities of the same material used, for all iron and steel is originally derived from pig iron made from iron ore. Broadly speaking, cast iron is used in intricate shapes, where lightness and tensile strength are not required. Where more delicacy and intricacy in design are evident and weight or thickness is a factor, malleable iron is used. Where even greater strength is required cast steel is used. Rolled steel and forged steel differ chiefly in the final shaping operation. For example, a tyre is rolled on a special type rolling mill, while an axle is forged or shaped under a hammer or press. Wrought iron is used principally in merchant bar, where advantage can be taken of the so-called fibre or toughness of the iron.

It may be well here to mention a very important factor as affecting the value of steel for any use, and that is its carbon content. In order to simplify the consideration of this important element in its effect on iron, we shall overlook the effect of manganese—a metal somewhat similar to pure iron; of phosphorous, most commonly seen as a constituent of the striking head of matches; of sulphur, recognized by its yellow color and commonly known as brimstone; of silicon and traces of other metals, all of which form compounds either with each other or with iron which affect the characteristics of the steel.

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*From a paper presented at a recent meeting of the Canadian Railway Club at Montreal.

†Engineer of Tests, Canadian Pacific Railway.

All are familiar with the effect of carbon in carbon tool steel and its results in making the tool hard when the steel is quenched from redness in some cooling medium. To show how various amounts of carbon affect steel Fig. 1 has been included.

This result is, of course, produced by heating the samples to redness and quenching in water and testing one piece in the hardened condition and a similar piece after annealing. It will be seen that the piece with .09 per cent. carbon, say one-tenth of one per cent., bends through 180 deg., but that with .21 per cent., say two-tenths of one per cent. of carbon, the hardened piece bent through only about 30 deg. before breaking and the piece with .47 per cent. of carbon, say half of one per cent., broke without bending at all. Now note that all the pieces bend through 180 deg. without breaking if they are annealed. This shows the hardening effect of carbon when the effect is produced by suddenly cooling the steel or the lack of effect if means are taken to prevent the carbon performing the functions of which it is capable.

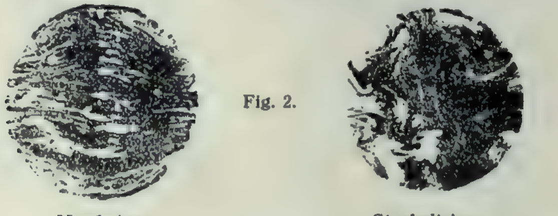


Fig. 2.

No. 1. iron.

Staybolt iron.

Here, then, is suggested the difference between low carbon boiler plate, which must be punched and bent, and low carbon tubes which must be beaded, all of which are soft steel as compared with tyres which are hard steel and must withstand wear. This hardness affects the tensile strength of the steel as well as its capacity to stretch or have "elongation," as it is commonly called.

On a locomotive, steels are used varying from one-tenth to seven-tenths of carbon, as follows:

.10 to .20 Carbon,
.2 to .3% "
.4 to .5% "
.4 to .5% "
.6 to .7% "
.7 to .8% "
1.0 to 1.10% "

Boiler, firebox plate and tubes.
Bolts for side rods.
Side and main rods, piston rods and axles.
Knuckle pins for couplers which are hardened in oil.
Cross head keys and tyres.
Spring steel which is specially hardened and tempered.

The reason for low carbon in plates and tubes, giving what is termed a mild steel, is to have a soft, easily working ductile material.

Bolts with .25 carbon cut with a cleaner thread than those with less carbon and have a greater tensile strength.

Axles, side and main rods, piston rods and crank pins with .45 per cent. carbon have fair hardness for wear and have good strength.

Knuckle pins, which are oil toughened, have a high shearing value and good wearing qualities.

Cross head keys have a high shearing value, tyres are hard for wearing quality.

Springs which are hardened and tempered have a high tensile strength and resistance to fatigue.

Here your attention is called to an interesting attribute which all the steels and wrought irons have in common, and that is, that if you took the same cross section and same length of bar of each and put the same load on each, the stretch would be the same, provided the elastic limit were not exceeded. The "elastic limit" is that limit which must not be exceeded if the material stressed is to return to its original shape. Steels which have not been hardened have the elastic limit one-half of the ultimate strength. For example—boiler plate, wth an ultimate strength of 55,000 lbs. per square inch, has an elastic limit of about 27,500 lbs.; steels which have been hardened have the elastic limit about two-thirds of the ultimate strength. This explains then why making a coil spring harder does not make it stiffer, though it is true that it may bend further and come back to its original shape, as compared with one not so hard.

A widely held idea is that wrought iron is fibrous in structure, while steel is crystalline, and for this reason staybolts which are subject to unknown stresses withstand better if made of iron. Fig. 2 shows the ends of bars of different irons which have been etched to show their structure.

Iron is made by welding many bars together and then rolling them out, and the difference in the amount of work put on these two irons is easily seen. Fig. 3 shows a fibrous fracture of iron and a crystalline fracture of the same iron, both depending on whether the nicking extends all around and the bar is sharply broken or not. For comparison is shown a fracture of steel of the typical crystalline kind, together with a fibrous, or perhaps more properly called, laminated steel fracture of a spring plate.

Much is heard about fatigue of metals. Fig. 4 shows a failure of that type. This is a crank pin which in service is pulled and pushed on two sides only. This is a fracture in detail because failure has taken place in detail or bit by bit. This type of fracture is often mistaken for a flaw in the material. Fractures in detail are common on axles or on any material which is alternately put into tension and compression many millions of times. Failures in detail are caused by overloading, by using too little material or allowing it to be used too long.

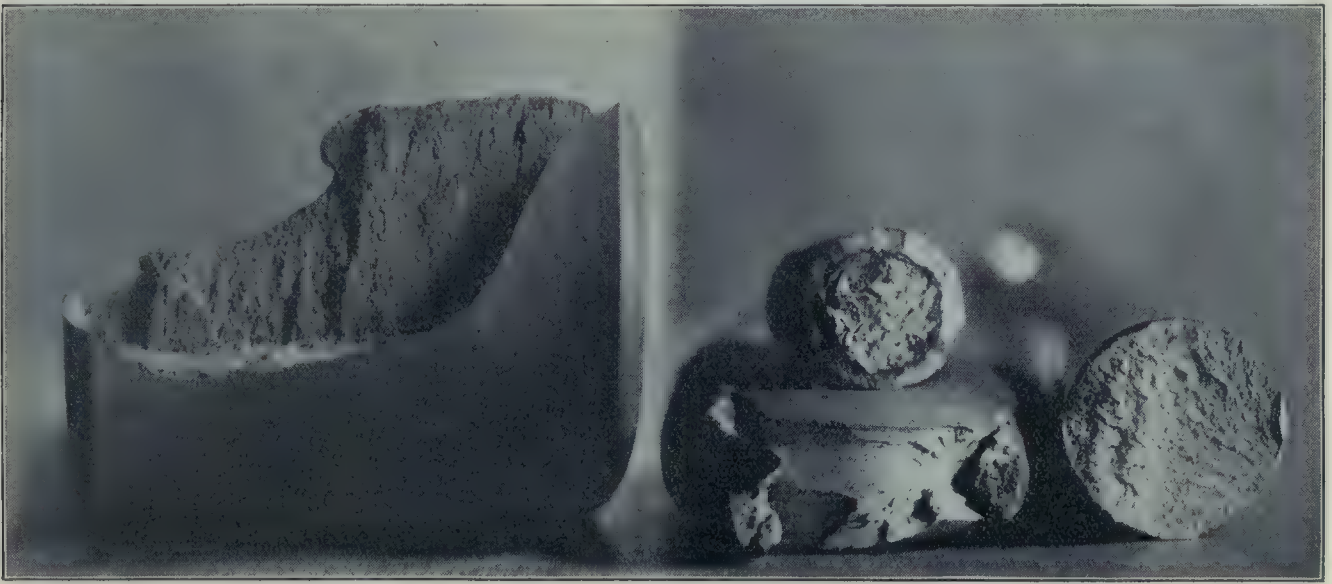
Again, material is said to become crystalline due to its use or abuse, which in turn causes failure. This belief in the growth of crystals is probably due to failures of iron, whose fracture showed to be crystalline, whereas a fibrous fracture would ordinarily be expected. In my opinion there is no change in the size of the crystals when temperature is not a factor in the use of material, and that the crystalline face on the fracture is due to the method in which failure was made—that is, the path of fracture has been altered as compared with what it would have been had the metal been fractured new without any use.

There are failures because of an inherent defect in the steel due to a pipe or cavity in the original ingot and there are a number of other defects, such as blow holes and segregations, which may occur in rolled steel. It is not intended, however, to dwell upon poor material as it is a very small proportion of the total used.

Cast steel is poured into a mold very much in the same manner as cast iron and is consequently used for intricate shapes where a stronger metal than malleable iron is required. In order to relieve the shrinkage strains due to casting and to increase the ductility, steel castings are annealed.

Malleable iron is now confined to small castings, thin in section and complicated in shape. Because of the fusibility of malleable iron at a low temperature, no greater moulding difficulties are found than with cast iron. Malleable castings when poured are chilled as white as the tread of a cast iron wheel and a long annealing is necessary to give to the iron its malleability and ductility. This malleability is due to the change in the condition of the carbon in the iron.

Cast iron is used for many purposes yet and the largest castings are locomotive cylinders and car wheels, very few driving wheel centres being made of cast iron now. Cast iron should not be used where it will be in tension, unless these stresses are very low.



Spring plate. Iron. Steel.

There are three principal grades of cast iron for railway use, the softest and weakest being known as machinery grade and comprising those castings which machine most readily; cylinder metal is stronger; and wheel metal is used exclusively for cast iron wheels. The chief characteristic of the last-named is that the iron must be capable of being chilled to form the tread. The interesting thing about these different grades of iron is that as in the case of the grades of steel already enumerated it is the carbon which is responsible for the difference in the irons. The total amount of carbon does not vary, but its condition does. In steel we have all the carbon in what is termed in the laboratory as "combined"—that is, it has combined with the iron to form a compound. In cast iron the carbon is in two conditions, either as graphite showing as black flakes or small black spots, or as "combined." The total carbon will be in the neighborhood of three and one-half per cent., but the combined carbon will vary from half of one per cent. in machine iron to one per cent. in cylinder iron, and to all "combined" in the white or chilled portion of a car wheel. The difference in the test bars obtained from these different irons is all due to the difference in the state or condition of the carbon.

Puddled or wrought iron is so familiar to all that it will suffice to say that while steel has taken many of the places previously filled by iron, yet the eminent suitability of iron for such work as stay-bolts and pins to be case-hardened has resulted in its being used for these and many other purposes. In addition to making a tensile test to determine the strength and ductility of iron, an etched section of the iron is made. This gives additional information as to how well worked the iron is. A test which is being used to distinguish between good and inferior irons is the so-called vibration test. In this test a special test piece is alternately put in compression and tension until failure takes place with a fracture in detail, as previously described in the case of the steel crank pin. Unfortunately, this test is not always conclusive as differences in testing give a greater difference of results than the differences in the material.

It is more difficult to tell the difference between iron and steel than the average person imagines, but shearing will very often tell the story, the iron being softer and shearing more readily. When this will not tell, etching will distinguish. Chemically, there is usually much difference, for we can compare the two thus:

	Carbon	Sulphur	Phosphorus	Manganese
Iron	.05 to .15	.02 to .07	.075 to .20	Trace to .20
Steel	.10 to 1.50	do	.02 to .10	.20 to .80

The greatest difference usually is in the manganese.

A very noticeable difference between mild steel and iron is the poor thread which cuts on mild steel, the metal dragging, while in iron a clean thread is readily cut. Steel makers, in order to make steel that will thread well, purposely leave the sulphur high and the phosphorous too, and much hexagonal cold drawn steel which threads so well is very poor material. So, too, in working. Hot steel is not formed as easily as iron and it is harder on both machines and dies to work steel than it is iron. Most of the common steel pipe is made from Bessemer steel, which is high in phosphorus, because this steel welds very readily and threads well.

It is often desirable to identify the variety of steel which may be under consideration, to know whether it has been made by the crucible process, the Bessemer process, the acid or basic open hearth process. At the present time the amount of steel made in electric furnaces is relatively small. Expensive steels only are made by the crucible method, say steel costing from 6 cents a pound up, so that price generally determines the use of crucible steel. The Bessemer steel is generally distinguished from the open hearth steel by its higher phosphorous content, 0.7 per cent. to 1 per cent., and its high manganese. It is very hard to distinguish between acid and basic open hearth and its source will often have to furnish the clue. Basic open hearth is usually lower in phosphorous and sulphur than acid open hearth, because it can be so made, but otherwise there is no way of readily telling which one has, either by physical tests or the chemical analysis. Usually it does not make much difference, though engineers will be found with preference for acid open hearth because of the initially better stock, from a chemical viewpoint, that is necessary to make it.

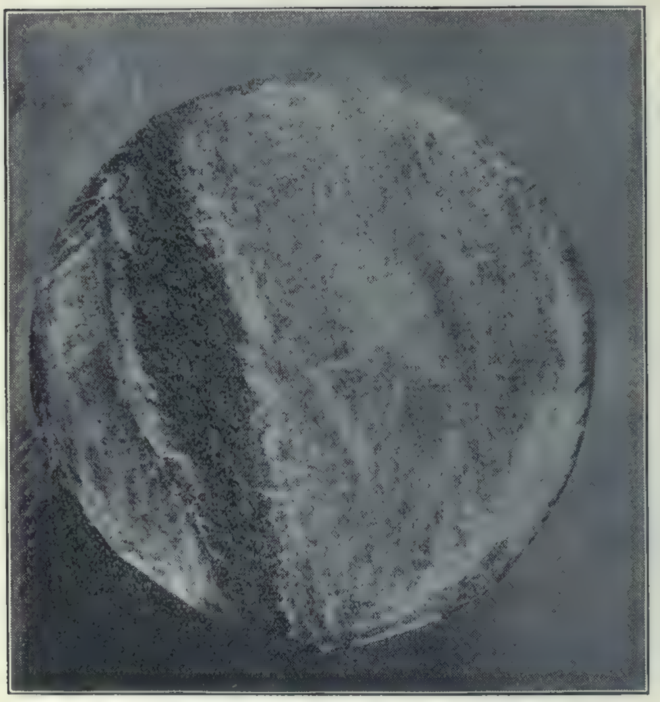


Fig. 4.—Illustrating a failure of the fatigue type.

In addition to the common steels, a number of alloy steels are used. The best known now are vanadium steels. They may be in any form that steel is supplied, and it will suffice to say that vanadium makes for soundness, and that these steels are heat treated. Where a steel is to be specially treated or "heat-treated," as it is termed, then chromium is also added, the chromium making the steel more susceptible to the effect of quenching. Vanadium steel is commonly used as castings in frames, with chromium for axles, rods, tyres, and springs, and it has been used in cast iron for cylinders. Manganese steel is most commonly used where much wear is encountered. Rubbing blocks on locomotives and knuckles of couplers are the principal uses. It takes from .12 per cent. to .14 per cent. of manganese in the casting, which is afterwards quenched to give the qualities desired. High silicon and manganese steel have been used for spring steel. Nickel and nickel chrome steels have not attained any great use yet in locomotive and car building.

Alloy steels are much used for cutting tools and we have the original high speed steels with chromium and tungsten to give the wonderful cutting qualities. Then the addition of vanadium improved these steels and gave a superior class of high speed steels. Latterly Cobalt has been added. This made an improvement, so that we have now the doubly superior steels. No doubt this will give a continued improvement, but it is expected that the English language will break down in attempting to supply adjectives to adequately express the quality, so we shall be reduced to using a letter, such as is supplied to describe the amount of work done on iron. The custom was to designate as B, BB, or BBB, in referring to the number of times that the wrought iron was worked, and this method has been so popular that the general public is now worked into accepting steel chain described as B, BB, and BBB.

The self-hardening tool steels depend largely upon tungsten for their properties. In high speed steels, as in carbon steels for cutting tools, it is our old friend carbon that gives the hardness forming the carbide of tungsten and of chromium, which remains hard at a red heat. The carbide of iron is soft at a red heat, hence high speed steels may be run at a red heat, while carbon steels must be run at a low temperature.

The bronzes, brasses, and white metals are a small but interesting group, and if we think that we know less about them than we do about iron and steel it is perhaps because the latter have received more study and attention. We do not consider a yellow or red metal as any more complex than cast iron, yet given the analysis of a piece of cast iron and some little history, we can fairly well tell its attributes.

Bronzes may be described as copper base metals with up to .10 per cent. of tin and some smaller amounts of lead and zinc, while brasses are a copper base with additions of zinc up to one-third the total weight. The bronzes are used chiefly for bearing metals and steam metals, while the brasses are for decoration. About a railway shop the bronze-bearing metals are usually known as "brasses," which is the old name for any mixture containing copper, but we consider bronzes the better term. Railway bronzes and brasses may vary somewhat on account of the melting of the return scrap, and a consistent effort must be made to keep them up to a given formula. Bronzes and brasses both cast well, and in addition to castings considerable brass in sheet form and pipes is used. The chemical analyses are the checks on the quality of these materials and indicate reasonably well the characteristics of the metals. In bronzes a reasonable strength is needed, and, if possible, total absence of porous or hard spots. In brasses color and soundness are the main considerations. An addition to this class of metals in the last few years is plastic bronze, which is a copper metal containing as much as .35 per cent. of lead. This is a satisfactory metal for bearing purposes and is reasonably cheap.

With the exception of locomotive rod, and driving box bronzes the other bronze bearings are lined with white metal. The white metal is lead with antimony, thirteen per cent. or less, and tin from two to six per cent. The antimony and tin are added to make the lead hard. Here it is as well to explain that lead is often termed a frictionless metal, but this is certainly a misnomer. There is no metal which produces more friction than lead does when used alone, but fortunately it is cheaply hardened by antimony and then becomes of greater value. The value of lead mixtures is the ease with which they change their shape to conform to any alteration in the relative position of the journal and the bearing; consequently there is always present a large bearing area. Theoretically, the lubricating material—oil or grease, forms a film between the bearing and the journal. The advantage of a metal which can adapt itself easily to keep this oil film or wedge unbroken and of greatest area must be a valuable bearing metal.

White metals, with tin as the principal constituent, have only a limited use in railway work and are used where the duty is exceptionally severe, either with excessive pressures or high temperatures, as for metallic packings. White bearing metals with a high content of zinc are not commonly used as far as we know, As with bronzes, chemical analysis is the principal way of checking up the quality of the white metals.

Rubber Products

The rubber products used by a railway are comparatively small in value but are of much interest. Hose for air, steam and water are the most important, and are now being purchased on specification basis with satisfactory results. As in every other line of industry, the use of scrap must be considered. With the advent of increasing amounts of rubber grown on plantations, the "Fine Para" rubber from the upper reaches of the mysterious Amazon River is forming a smaller part of rubber products than formerly. In hose we look for the cotton duck to give the strength and permit of sufficient flexibility, while the rubber protects the duck and makes the hose air, water, or steam tight. As yet, physical tests, including stretching and recovery, and the strength tests are the principal ones to gauge the quality of the rubber. The chemical analysis of rubber is more widely done now that standard methods are promulgated by the chemical societies and a reasonably accurate measure of the constituents of any rubber is now readily made and the amount of new and old rubber determined.

Physical tests on the strength of the duck are made also, so that the physical and chemical tests, together with the knowledge of the physical construction, permit one to make a reasonably good judgment of the service which may be expected from any sample of hose.

The problems of the rubber hose maker are varied, for it can be seen that with rubber compounds and cotton duck he must provide steam hose which must be flexible when used at a temperature of 250 deg. F. or more, while with the same material air brake hose must be flexible at 25 deg. below zero. That this is successfully done is an indication of the skill of the rubber manufacturer.

Paints

Paints form one of the interesting groups of materials. Often the paint manufacturer and the chemist are not in agreement as to what constitutes the best paint for any particular job. There are good paints and plenty of them, but there are poor paints and perhaps even more of them. Paint-making has not yet emerged from the stage of shop formulae and trade secrets. Until such time as paint-making is as open to the engineering world as the iron and steel industry, or as the rubber industry is becoming, there will always be considerable disagreement and dissatisfaction. After all is said, service is what is desired in paint as in everything else that a railway uses. The great difficulty is to agree upon what constitutes satisfactory service.

The present most satisfactory way to buy paints is to have a color card, specify the consistency of the paint desired and leave the rest to the paint manufacturer. In specifying any composition one is usually opening up a fruitless discussion. Linseed oil is still the most satisfactory paint oil. While other oils are being used and with success, linseed oil has not been displaced. Within the last few years there has been much good literature published in connection with paints and much testing work has been done jointly by paint manufacturers' associations and engineering societies. Progress is being made, and the final result is not as hopeless as these remarks on paints would lead one to believe.

Lumber and timber, while forming an important material, is not on a written specification basis like many other materials. This is brought on grades, men skilled by experience in the working up of lumber judging as to the suitability and quality of the lumber shipped. Specifications are used and merchant lumber associations have definitions of grades and imperfections. The inspection of lumber will probably remain in the hands of the men who make its production and use their life's work.

In drawing up specifications, the characteristics of materials are described or exhibited by the tests, but sometimes a specification is criticised in that the tests asked for are not those which show the suitability of the material for the use to which it is to be put. For example, the quenching of a piece of boiler plate or boiler tube at a red heat in water and the requirement of subsequent bending without cracking is not anything like what the material is subjected to in use. But this test is a check on the carbon, for low carbon material is desired, and this method of checking the carbon content is quicker even than a laboratory analysis and quite as satisfactory.

An enumeration of the characteristics of materials is not the only thing necessary to ensure good material and the manufacturer's assistance in giving "full measure," so to speak, in meeting the requirements, together with the manufacturing skill of his organization, will ensure a generally better material than where an effort to just meet or beat the specifications is aimed at.

No claims of originality are made for the information contained in this paper, and it is only desired to treat in a popular way some of the characteristics of the more important materials. Much will have been done if you have been interested in a subject generally considered "dry," and if it has stimulated your interest in these things nothing more is desired.

Asphalt paving on a plank base is being used successfully in King County, Washington, particularly for increasing the service that may be expected from roadways supported on wooden trestles. An untreated planked trestle in the vicinity of Seattle has worn so rapidly that after about eighteen months of service it has become rough, and the automobile traffic, in particular, avoids it in favor of other routes, although the wear is not yet sufficient to warrant renewal. A 2-in. asphalt wearing surface on a substantial 5-inch plank trestle flooring has been in service for seven years on one of Seattle's main automobile suburban routes, and only moderate patching has been required. The longest service may be secured, it is said, by applying the asphalt when the plank is thoroughly dry, and if this is done the roadway should last, assuming good workmanship, until dry rot destroys the plank.

Modern Practice in Refuse Disposal*

An Outline of Satisfactory Methods Adopted in England and France — Vehicles in Use — Sorting the Refuse — Systems of Disposal

By Prof. E. R Matthews, A.M. Inst. C.E.†

IT is now the custom in most coast towns for the refuse to be collected during the summer months at night, the carts leaving the depot about 11 p.m. and returning about 7 a.m., and this method should certainly be adopted in all health resorts. The disadvantage of this plan, of course, is that the noise of the carts as they rumble through the streets at night is disturbing, but the advantage of not having them in the streets during the day quite outweighs this disadvantage.

In many towns the collection of the house refuse is let to a contractor, a method which I entirely disapprove, for the corporation can carry out this work more efficiently, and the fact that in some towns where the work was previously let to a contractor the corporation now do the work endorses my view. Not only so, but contractors, when their term for the removal of the contract expires, frequently put their price up very considerably, and that means usually that the work is let to a new contractor who knows nothing of the nature of the work.

In some parts of the country a good deal of the refuse is saleable. Mineral-water bottles, for example, can be sold; tins, if crushed, and put on rail, are bought; paper and cardboard, glass and crockery in some districts have a small value. It is never advisable for rags to be picked out and sold, for these are likely to convey infection.

It has been suggested that in laying out a new city each house should be connected up to a suction main, which would lead to the destructor, and that house refuse should be thrown into a hopper in the kitchen, which would be connected with the main; the refuse would thus be drawn by suction to its destination. Theoretically this is admirable, but many difficulties present themselves in practice.

In some towns it is the practice for the man who collects the refuse to bring an empty bin and take away the full one. This is an advantage, for it obviates the nuisance of the refuse being blown about as it is being tipped into the cart or wagon.

Vehicles Usually Employed

Ash Carts.—The old-fashioned ash cart is still in use in many towns. This is usually fitted with a canvas cover, which is so arranged that it can be drawn over the piled-up refuse, and lashed down by means of cords. The disadvantage of this method is that while the cart is being loaded the refuse frequently blows off and litters the street, and in a very heavy wind it is almost impossible to prevent this. Carts of this type should certainly be fitted with indiarubber where the tail-board is placed, and it is better that the tail-board should drop into position vertically in a grooved frame rather than that it should be hinged.

Covered Carts.—Instead of the canvas cover, ash carts are now made with a permanent cover, which may be raised or lowered as required, and this is a great improvement on the open cart with the canvas cover.

Covered Vans.—The Corporation of Leamington Spa and many other corporations have adopted the covered van in place of the canvas-covered ash cart, and these are admirable where the roads are fairly level, for they are capable of conveying about 3 tons of refuse. In a hilly district two horses would be required, and therefore it is not economical under those conditions to adopt the covered van.

Motor Vehicles.—These are in use in one or two towns in this country for the purpose of conveying the refuse to the destructor, and the power is usually derived from the burning of the refuse. In France this method has been largely adopted. The Municipality of Paris has a large number of motor vehicles engaged in this work. At Havre, Nancy, and other French towns these vehicles are in use. "The Fram" vehicle seems to have met with most favour on the Continent. We in this country have not adopted this method of conveying refuse to the destructor unless it be in an isolated case, but I have no doubt that we shall do so in the near future, although up to the present I have not been satisfied that there is any saving in cost over the ordinary horse-drawn vehicle, chiefly on account of the time the vehicle must necessarily have to stand idle in the street. For other municipal purposes it is admirable.

Unsatisfactory Methods of Disposal

Every local authority should consider which is the best and cheapest method of disposing of their town's refuse. In many towns this contains a large percentage of nightsoil, in others it contains none. Here and there throughout the country one finds the town's refuse being tipped in old quarries and disused brickfields. Such methods of disposal are far from satisfactory, for there is a danger of contaminating the water supply, and if not, to have a nuisance of this kind in the district must be injurious. In one of our Midland towns the household refuse is carted to the depot, where it is drawn up an inclined plane on to a strong horizontal screen of 2-in. mesh fixed at a height of 10 ft. above the ground level. On one side of the screen a furnace has been constructed, and into this paper, rags, etc., are thrown and destroyed. Two labourers working on the screen salve bottles and old tins, the remainder of the refuse dropping through the screen. This is received on an inclined riddle of ¾-in. mesh, and the larger ash is deposited outside at the ground level, and sold to market gardeners for use as fuel in rhubarb-forcing sheds. The finer ash which falls through the riddle is deposited in a pit beneath. Tanks are constructed in the yard, and this ash with the addition of the nightsoil is converted into manure, which has a ready sale to farmers in the district.

In some places it has been the custom for the refuse to be taken direct to the farmers in the district, but it is only during certain periods of the year that this refuse is of any use to the farmer, and so, during many months of the year it has to be stored until the farmer is prepared to receive it.

The refuse in other towns is taken by rail direct to

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[*] From a lecture delivered recently at University College.

[†] Chadwick Professor of Municipal Engineering in the University of London.

the suburbs, where it is used by farmers, market gardeners, and others. The loading and unloading of this is often a great nuisance.

In several coast towns, such as Dover, and other towns which are situated near the cost, such as Sunderland and Newcastle, a part, if not all, of the refuse of the town is taken to sea in barges, and there disposed of, but this method of disposal is a very objectionable one, its disadvantages being—(1) the system costs, with the purchase of barges, etc., as much as a refuse destructor; (2) during an onshore gale much of the refuse already tipped will wash ashore; (3) during a gale, which might last for a week, no refuse could be taken to sea, and therefore it would have to be stored somewhere; (4) the loading of the barges would, no doubt, have to be done from the piers of the harbour, and this would be an intolerable nuisance; (5) only at certain states of the tide, in most seaport towns, would the barges be able to get out of the harbour; (6) it is very doubtful if the Fishery Board will allow refuse to be tipped in the sea in the manner referred to when they really give this matter their serious attention.

It has often been suggested that a town council should purchase a piece of low-lying land, preferably of a clayey nature, well out in the country, and remote from the water supply of the town, or from any wells in villages, and use this as a tip for the refuse, and that they should purchase a traction engine with trailers to convey the refuse there. The disadvantages of this suggestion are that the rural district council would certainly object to the tipping of the town's refuse in their area, the cost of this method of disposal would be prohibitive, and when snow was on the ground the refuse could not be taken, but would have to be stored in the town for perhaps two or three weeks.

Sorting of Refuse in the Home

It has also been suggested that the refuse should be sorted in the home, and that separate receptacles should be used for receiving—(a) waste food, vegetable refuse, etc.; (b) ashes and dust; (c) other refuse, such as tins, broken glass, paper, etc. While this is very good in theory, in the actual carrying out of an ideal system of this kind many difficulties present themselves. This principle has been adopted in some towns in Germany, but has certainly not proved a success. The local authority can, however, be considerably helped by the housewife, if she will destroy by fire all the organic refuse of the house, so that there will be nothing to remove but ashes. This is an ideal state of things, but unfortunately the public have not yet been educated up to this standard.

Disposal by Conversion into Manure

There is great difficulty in disposing of house refuse to farmers, owing to the large quantity of paper which it contains, and which the farmer naturally objects to place upon his land. In order to pulverise refuse and make it useful as a manure a factory was erected at St. Ouen (Paris) in 1896, and two further factories were erected—namely, at Issy-les-Moulineaux and at Romainville. Shortly after the farmers began to purchase this manure, and found it excellent; but after they had treated their land with it for three or four years they found that its beneficial effect had lessened—the land needed a change. They discontinued using the manure, and the companies failed.

Patent Lightning Dust Manipulator

This machine has been brought out by a British firm, and is undoubtedly the best of its kind.

The object of the plant is to treat the refuse so as to enable it to be used as a valuable fertilising agent. The plant may be described briefly as follows: A high-speed centrifugal-force disintegrator, pulveriser, and mixer of a simple construction, it costs much less than a destructor, occupies little room, requires only a moderate power to drive it, and any material capable of pulverisation is instantly disintegrated and pulverised; the machine is certainly a very useful one. The house refuse is tipped by the ash cart in front of the manipulator, and is then shovelled into the hopper of the machine. Almost anything can be treated, and a few seconds after the refuse is discharged into a cart or truck in the nature of a dark-coloured mould or manure. The refuse may contain rags, paper, cinders, glass, pots, bottles, or almost anything.

It was first adopted by the Southwark Borough Council, and one or two extensions of the plant there have since been made. On one occasion at Southwark 6 tons of condemned rabbits from Australia, 5,000 in number, and in their skins, were passed through the manipulator and promptly turned into manure.

Three of these machines are now at work at the depot of the Southwark Council, and a fourth has been installed as a reserve.

Problems of Railway Sanitation*

By E. J. McCaustland

PASSENGER railways of this country from the nature of their business offer a ready and rapid means for the spread of disease. Infected persons may occupy railway carriages and by close association with other passengers cause a wide extension of infection. The water on the trains may become contaminated. Through the common methods of toilet accommodations typhoid or other germs may be scattered abroad to pollute sources of public water supplies. The common drinking cup, the roller towel, the cake of soap, and indeed many other things, may cause trouble and should be properly guarded against. It follows from these facts that railways have been obliged to meet a public demand for cleanliness, comfort and healthful conditions in a constantly increasing degree. In addition to the more pressing demands for strictly modern methods of heating, ventilation and lighting for railway carriages there has been a further insistence upon special protection of food supplies and of the water served upon the trains. These demands, it must be confessed, have not always been based on scientific knowledge, but have been, at times, conceived in pure sentiment or urged in a spirit of retaliation or reprisal.

To meet and possibly forestall some of these difficulties the American Association of Railway Surgeons has made an attempt to get together with State and Municipal health officers with a view to prevent rapid spread of disease through the agency of the railways. If health laws can be harmonized and unified as between States a long step in advance will have been taken. To the credit of the railways it must be said that they have responded in a comparatively prompt manner to the public demand for better and safer car heating and lighting. Their ventilation systems are at least as good as those of the ordinary places of public assemblage when the difficulties of their problem are taken into account.

While the dining car service on trains is usually found to be entirely satisfactory, and reasonable care is exercised as to quality and cleanliness, yet the travelling public is not generally aware of the practice of using the dining cars as sleeping places for employees. This is a practice that should be entirely discontinued in the interests of public health. The matter has received the attention of various State authorities, but like other questions of the sort, numerous different plans for relief have been suggested and there is no general rule adopted. Whatever plans may finally be adopted, they will, of course, add to the difficulties and the expense of operation.

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* From the Proceedings of the St. Louis Railway Club.

The quality of the water supplied to patrons by the railways should be beyond suspicion. This is of prime importance since many of the common intestinal diseases are transmitted by means of the drinking water and a supply of undoubted purity should be demanded of all who undertake to serve the public.

The Interstate Commerce Commission took action some time ago requiring all passenger railways to furnish semi-annual certificates of purity of all waters used for drinking purposes on their trains and in their stations and waiting rooms. In carrying out this regulation the various State Boards of Health have been called into co-operation and the tests have been made in State laboratories. The certificates thus secured by the railways are therefore strictly official. The effect of this order has been most excellent since it has served to unify practice throughout the country and at the same time fully satisfy the State authorities.

In the matter of handling passengers afflicted with contagious diseases only one general rule applies. Such passengers should be removed from the public conveyance at the earliest moment and placed in the hands of local health officials. In theory this is a simple matter, but in practice it is not so easy to carry out. Contagious and infectious diseases are not always readily recognized or positively identified; afflicted persons are not always tractable; local health officials do not joyously accept trouble and expense; trains must conform to schedule and conductors are human. No really satisfactory means has yet been devised to provide for the isolation and care of travellers afflicted with contagious disease, although the railways of the Northwest in conference with State health officials at Helena, Montana, in 1912, suggested regulations that have since been pretty generally adopted by the States of the Northwest.

The care of passenger cars and the provision of toilet facilities on trains have been very much improved in recent years, but without question there must be radical improvements in the near future. With all the conveniences and luxuries of this strenuous modern life, the simple, sanitary and complete removal of wastes from our palatial trains is still an unsolved problem. Furthermore, such removal as now exists, while it may satisfy the comfort and convenience of the passenger, is certain to become both a nuisance and a menace to health to other persons.

But, it will be asked, what can be done about the matter? The answer is that the time has come when we must insist that if a railroad company finds it practicable to carry large iron tanks under passenger cars for gas or for refrigerator purposes, it can and must also carry there an iron tank for sewage. If for any reason this is impracticable, earth closets with pails frequently changed may be used. Railroads must somehow cease distributing fecal and urinary matter all along their lines. The sewage tanks or pails could be emptied at selected places, either at the end of the run or, on long runs, at principal stations, precisely as water and gas are now taken into special tanks at principal stations.

The sanitation of way stations and terminals is a problem in itself. Who is not familiar with the way station privy, foul and ill-smelling, with its unscreened windows, a pollution to both soil and air, a harbor for flies and a possible centre for the spread of infection? Shall it always be so with us? How simply and cheaply might be substituted the concrete-lined pit, and concrete floor, the tight door and the screened windows, a proper ventilation shaft and a periodic system of cleaning. These changes are coming and however inequitable it may be, they are likely to precede the same standards for the average citizen.

Finally there is another phase of railway sanitation which is the direct outgrowth of modern ideas relative to the spread of disease. It is well known that the discharges from patients suffering with such diseases as typhoid fever are highly infected and capable of spreading the disease widely if allowed to pass into a body of water used as a source of supply. Now railway lines are frequently located along streams or through watersheds from which public water supplies are taken. The roadbeds of these lines are highways for tramps and for employees and passengers. It becomes necessary at times to isolate the railroad right-of-way from the area of the watershed in order to preserve the water supply from possible pollution.

Furthermore, some authorities hold that the continuous use of railway toilets is resulting in a gradual infection of thousands of miles of roadbed. Dr. Barringer, President of the Virginia Military Institute, says: "I believe that in the well-drained, but cool and moist soil under the ties and ballast of a modern railway roadbed baptized day after day and year after year with the albuminous fluids of human excrement, the bacillus typhosus once planted in this natural culture medium, will lie forever, revitalized by new infection, perhaps, but in the meantime facultative enough to meet seasonal and other changes and remain potent. Such infection will affect people living along the line by direct contact and by the pollution of brooks, creeks, wells and other sources of water supply. It will also affect the general travelling public through the clouds of dust raised from the roadbed in the passing of trains. It is well known that travel increases one's chances of typhoid, and railroad hospitals report a very high percentage of typhoid patients among section hands. These facts all offer even a more positive reason for the abolishment of the present methods of caring for the sewage from trains."

Calgary is congratulating itself on an expenditure of some $4,000,000 on building work this season. This is considered highly satisfactory in view of the slump in western building work caused by the outbreak of the European war. It is somewhat of a paradox, however, to find that the best monthly report was for August, the month in which the war started. In August the permits totalled $1,125,000. As an aside it may be pointed out that of this amount the Government elevator was responsible for $800,000, but the cheerful fact remains. It is hoped that the Government will proceed with its various city works during the coming winter. A continuation of the programme will mean an expenditure of more than a million dollars. The West needs all the encouragement it can get for a time.

Building and Equipment of Calgary's New Police Headquarters

(Staff Article)

THE City of Calgary has occupied the new Police Headquarters completed recently, a fully fireproof structure with reinforced concrete frame. The building occupies a large open site by the City Hall and is admirably suited to its surroundings. The exterior is of local red face brick with sandstone trimmings, quarried locally, the structure being five storeys in height. Construction was commenced in July, 1913, when the general contract was let. The building was practically ready for occupancy the following June, in spite of some four months' delay during the winter months.

The concrete work was completed in two months—at the rate of a storey every two weeks. The building has a frontage on Seventh Avenue of 75 feet. It is 86 ft. deep and 58 ft. 6 in. high above the basement floor, with a total floor area of 27,400 square feet and cubic contents of 344,500 cubic feet. The by-law for this building amounted to $165,000, which is a cost of 48 cents a cubic foot, the other items of heating, ventilating and plumbing, electric lighting, elevator, police cells and architects' fees and superintendence amounting to 18 cents a cubic foot. Of these, the largest single item was for the complete system of ventilation, heating and plumbing—amounting to a trifle over 8 cents a cubic foot. Electric wiring amounted to 7/8 cents a cu. ft.; elevator to 2 1/3 cents; excavation to 1/2 cent; foundations to 1/2 cent; reinforced concrete to 8 cents, and interior finish (plastering, painting, trim, etc.), to about 2 cents a cubic foot.

There were a total of 925 cubic yards of reinforced concrete placed in the superstructure. The Kahn system of reinforced concrete was used, a beam and girder design being found to be the most economical for the conditions to be met. There are seven rows of columns across the building, the longitudinal spacing being broken by the police court, which runs through two floors. This court room has a width of 30 feet and is 52 feet long, with a height of 25 feet. The floor system and ceiling girders are carried across the clear width of 25 feet. There were a total of 84 tons of reinforcing steel used, placed at a cost of from $6.125 to $6.75 a ton. The form design was simple and differed principally from the usual type for beam and girder floors in that the floor joists were laid flat. This design required about 8½ feet B.M. per sq. ft. of floor area, and lumber was used about 2½ times. The labor cost for forms amounted to about 1¾ cents per cu. ft. B.M. or 15 cents per sq. ft. of floor area throughout. The design of the reinforced concrete required an average depth of 0.85 ft. of concrete per sq. ft. of floor area, which cost from 22 to 25 cents per sq. ft., or 2 cents per cu. ft. of building. Aggregate was dumped on a plank floor alongside the mixer and was fed to the mixer by wheelbarrows. An 11 cu. ft. Cube mixer, gasoline-driven, was used, and all the concrete was hoisted in a "home-made" bucket by a 7-in. by 10-in. American Hoist & Derrick Company, double-drum, double-cylinder, engine. Six cu. ft. hand carts were used for conveying the concrete to place in the forms.

The exterior walls consist of 8-inch hollow terra cotta curtain walls between the columns, with a 4-inch face brick veneer outside the columns and wall girders. The basement walls are of local sandstone, with interior furring, carrying the veneer wall, although the veneer was well bonded into the tile walls with galvanized, corrugated, wall ties. It would have been better, perhaps, had the brick veneer been bonded into the tile curtain walls by headers, but the local market afforded none of the requisite size hollow tile for such work and to use ordinary brick would have defeated the purpose of the hollow tile backing. The face brick used was of a smooth texture and was laid up with a fairly thin flush joint, except certain pilasters on the front elevation, which were laid with rough-textured brick and wide raked joints. The roof over the police court is used for lighting the room and consists of a flat ceiling of blank prism glass carried by a grillage of reinforced concrete beams, and covered by a peaked roof of ribbed wire glass carried on steel trusses. The interior trim is of quartered oak stained green. The walls are all plastered, with sand float finish, and tinted. The floors are oak, with oil finish.

New Police Headquarters, Calgary.

Every room is supplied with ventilating ducts and fresh air is pumped in and foul air removed by fans located in the basement and the pent-house. Two boilers of 5,000 sq. ft. radiation are set in the boiler room in the basement and supply steam for heating. A garage on one corner against the lane houses the police patrol automobile as well as two other cars. On the other rear corner is an enclosed fire tower, a gallery along the rear of the building giving indirect access from the opposite side.

In the basement are located the police cells, forty in number, of which eight are tool-proof steel, with special locking control. The eight cells for women are separated, and under the charge of a matron. On the first floor there are the offices and police court, the two floors above being devoted entirely to the necessities of the police force. There is a large gymnasium, a guard room, telephone and police control system central, photographic laboratory, etc. The top floor is occupied by the Health and Sanitary Departments.

Messrs. Thomas-Jamieson-McKenzie, Limited, of Calgary, were the general contractors, for whom Mr. John Malloy was Superintendent. Messrs. Campbell & Hillier, of Calgary, were the contractors for the plumbing, heating and ventilating; Noble & Wood, of Calgary, electric wiring; Otis-Fensom Elevator Company, Limited, Toronto, elevator. Sub-contracts for the plastering were let to McDonald & Ward; for interior trim and other wood work, to the Riverside Lumber Company, Limited; sheet metal work and roofing to the Sheet Metal Manufacturing Company, Limited,—all of Calgary. The cell work was let to Tease & Perse, Limited, Calgary, local agents for the Canada Steel & Wire Company, Limited. The rough face brick were manufactured by the Tregillus Clay Products Company, Limited, Calgary, and the balance by the Canada Cement Company, Limited, near Calgary. Sandstone was supplied from the quarries of the Western Canada Stone Company, Limited, Calgary.

The architects were Messrs. Lang & Major, Calgary. Mr. W. W. Hay, formerly Secretary-Treasurer of the Calgary Builders' Exchange, was supervising engineer and clerk of the works for the City until the completion of the rough work, when the active supervision was undertaken by the Department of Buildings, of which Mr. H. A. Sylvester is Superintendent.

Constructional Features of a Large New Bakery at Montreal

OF the many important industrial buildings which have been erected in the commercial metropolis of Montreal in recent years, none has more interesting features of design and construction than the large new bakery which is now being erected for Messrs. Strachan, Limited, by the Peter Lyall & Sons Construction Company, Limited.

The large extension, which is now under way, comprises a four-storey building immediately in front of and adjoining the present establishment, with a frontage on City Hall Avenue of 167 feet and a depth of 63 feet. The construction is reinforced concrete. The front will be of a buff Kittanning brick, with blue Wallace stone trimmings and copper panels and cornices.

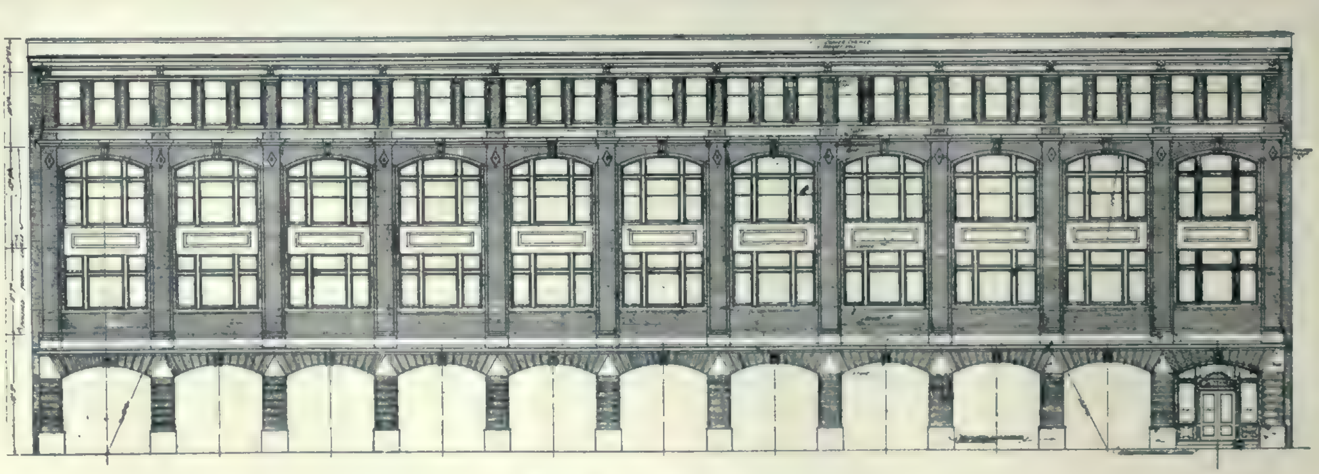
The basement is taken up by steam boilers for power and heating purposes, four large furnaces to a new travelling oven which will be installed, large fuel bunkers, general storage room, lavatories (including bathrooms), locker room, vault and other conveniences. The ground floor will be used for bread packing and loading, there being accommodation for an additional sixty wagons. These will enter and leave the building through ten large driveways, which will be closed by means of large rolling metal doors. The whole loading space will be paved with Staffordshire blue brick, and will be well drained. A separate entrance is provided to the stables, which are also being enlarged. The stables, though entirely separate from the bakery, will be accessible from the loading room.

A large freight elevator will be served from this yard, which will have direct access to both the old and the new buildings on each floor, including basement. From here also a special hoist will be provided to carry the flour directly up to the flour storage department on the fourth floor.

The main staircase will be entirely enclosed and will run from basement direct to roof. Access to the offices, which occupy the north end of the building on each floor, will be through an imposing and spacious entrance, with ceramic floor and marble dado. The staircase will be of ornamental iron with marble treads and will lead directly to the enquiry office on the second floor.

On the second storey, in addition to the new travelling oven, which will provide baking space 90 feet by 9 feet 6 inches, there will be installed a complete automatic bread plant. Provision is also made for cooling and wrapping the loaves by machinery, which will then be discharged by means of conveyors into the bread room. The finish to this storey will be metallic cement hardened.

The third floor, comprising the dough room, has an area of nearly 8,000 square feet. The temperature will be regulated automatically, and a humidifying



Front Elevation, Strachan Bakery, Montreal plant will be installed. The dough room floor will be finished in maple.

The fourth floor will be used chiefly for storage purposes.

Lavatory accommodation is provided on each storey. The floors and dados will be tiled, with marble divisions. All is exceptionally well lighted and ventilated. The lavatories in each case open off the main staircase hall and not direct from the bakery.

A laboratory, for testing and experimental purposes, will also be provided on the dough room floor.

The architect for the building is Mr. Sydney Comber, Westmount, and the general contractors are Messrs. Peter Lyall & Company, Limited, Montreal. Messrs. Purdy & Henderson are the consulting engineers. Messrs. F. J. Jago & Company are the contractors for the reinforced concrete. The automatic plant is being installed by Messrs. Jos. Baker, Limited, Brantford and New York. The particulars here given are abstracted from a comprehensive article in the "Baker and Confectioner," Toronto.

The Year's Building at Montreal

(Staff Article)

THIS has been a comparatively lean year for Montreal and district contractors and allied firms. It was generally expected there would be a lessening of the previous activity, but no one was prepared for the great falling off which has taken place. While the war is responsible for a portion of this dullness, conditions prior to the outbreak were not favourable to a continuance of the expansion which characterized the previous two or three years. In certain directions, there has been over-building; the number of large offices erected is out of proportion to the demand, with the result that both in the up-town districts and down-town districts there is an abundance of this class of accommodation. Up to this year, there was a scarcity of small houses and flats, and many contractors therefore gave more attention to this work; the emigration, however, was not as large as in previous seasons, and consequently there is not the eager demand for residences as was formerly experienced. Naturally the war affected the earning power of many people, and this in turn had an influence on the renting of houses. The building permits give a fair indication of the general situation: Up to the end of November the value of permits issued was $17,277,311, a loss of $8,446,556, the decreases being most marked since the declaration of war.

Directly following the European conflict, work on many buildings was stopped, impending contracts were postponed, and some that had just been closed were cancelled. On certain structures work has not been resumed, or only on such portions as could not be delayed. The banks, too, declined to make the customary advances, and this has tied up other jobs which would otherwise have been completed. The partial breakdown of the contracting business severely hit many of the supply houses; these, however, continued to do a satisfactory business with country firms, who were fairly well provided with contracts, an abundant harvest being a favourable factor in keeping things going.

The Montreal labour situation has been more or less disturbed during the season. The General Contractors' Association concluded arrangements with some unions for a schedule of wages which war conditions made impossible in the case of many firms outside the association. As a matter of fact, there has been a large defection from the standard rates, due to the circumstance that, owing to scarcity of work, men were willing to accept considerably lower pay. Contractors who based their bids on this reduced scale were able to secure jobs at the expense of the firms who attempted to adhere to the scales previously in force. An effort was made by the Builders' Exchange to secure the consent of the unions to a modified scale with a view to inducing capitalists to recommence building, but the Unions vigorously protested against any attempt to cut wages, while several members of the Exchange were opposed to the movement. Some contractors were willing to co-operate by building at cost, in order to keep their men and plants employed; and the supply men also offered to reduce prices. The net result was that no definite action was taken to encourage the giving out of contracts during the fall.

The principal work of the season was in the direction of industrial plants. We have already described the immense plant of the Canadian Vickers, Limited, at Maisonneuve, which establishes a new industry in the city; on the south shore, at Longueuil the Armstrong-Whitworth Company, of England, have put up a large plant for the manufacture of high speed steel and tools; while in Montreal proper the Northern Electric Company are erecting a very extensive factory for making wire and cable. Outside the city there is the hydro-electric plant of the Cedars Rapids Manufacturing and Power Company, one of the most complete on the continent, which will supply Montreal as well as the Aluminium Company, at Messina, N.Y., with a large amount of power.

Among office buildings, first place must be given to the Sun Life, which is now nearing completion. The Drummond and Lewis Buildings are also important in this class of structure; the Guarantee Trust have erected a moderately sized building, while the Royal Trust have finished one of the finest office buildings in the city. The National Trust Company are putting up a new office in St. James Street; the Dandurand and Southam Buildings are completed, and the Liverpool & London & Globe office is nearly finished. Several contracts for banks have been given out.

The new customs warehouse is a very imposing structure; the foundations gave a considerable amount of trouble owing to the unlooked for character of the ground, and this resulted in the Foundation Company being called in. The Government have also erected some post offices, the principal being on St. Catherine Street West and on Greene Avenue, Westmount. A new drill hall has been constructed on Esplanade Avenue.

A very large departmental store, Scroggie's, was opened during the year, this being the only work of this nature to report. The Bell Telephone have made two or three additions, the largest being on St. Denis Street.

Several churches and schools have been or are being built. St. Michael's Roman Catholic Church will be one of the most ornate in the city; an addition to St. Patrick's Church is practically finished, while the Stanley Street Presbyterian Church and the Dominion Methodist Church, Westmount, are fine additions to the ecclesiastical architecture of the districts. The new High School is the most important of the schools. A very extensive college, Loyola College, to cost $400,000, is being erected at Notre Dame de Grace, and an orphanage, involving an expenditure of $175,000, is going up in the same neighborhood.

In Maisonneuve, apart from the buildings already referred to, the chief work has been the construction of a civic market.

The City of Montreal have done a large amount of work, although financial conditions have been against any very heavy outlays on municipal buildings. A civic library is to be erected, while a considerable outlay was necessitated for a new intake pipe for the water supply.

The Canadian Northern Railway Company have continued their work on the Mount Royal tunnel, and also propose to erect a temporary station to deal with the traffic. The Canadian Pacific have spent further large sums on the Windsor Station, and in laying out new tracks, sheds, lighting, etc.

Personal Mention

Mr. I. S. Osborn, Consulting Engineer, Toronto, Ont., has been retained to assist Mr. J. W. Paxton, Superintendent of the Street Cleaning Department of Washington, D.C., in the preparation of plans for a system of refuse collection and disposal.

Mr. A. D. Swan, consulting engineer and late assistant engineer to the Montreal Harbour Commissioners, Montreal, has returned from a two months' trip to England. He was formerly connected with the Bristol docks, and his visit was in connection with a lawsuit by Sir John Aird & Company, contractors, against the Bristol Corporation for work on the new Avonmouth docks. Mr. Swan gave evidence for the Bristol Docks Committee, who won their case against the contractors. The arguments were heard by an arbitrator.

Mr. Clifford Older, the author of an interesting paper entitled, "Floors for Steel Highway Bridges," read at the Convention of the American Road Builders' Association in Chicago last week, and reproduced in this issue, is a graduate of the University of Wisconsin. For a time he was employed by the Pennsylvania Lines in their Bridge Department and later he became identified with the Maintenance Department of the same company. From July, 1901, to April, 1902, he was Assistant Engineer on the Green Tree Tunnel Construction of the Wabash & Pittsburg Terminal Railroad. For a period of some four years, terminating in July, 1906, he was Assistant Engineer in charge of construction on the Western Division of the Chicago and Alton Railroad. Since the last-named date until the present time, he has been Bridge Engineer of the Illinois State Highway Commission, and has contributed many interesting technical papers and discussions out of his broad, practical experience. Mr. Older is an Associate Member of the American Society of Civil Engineers.

Mr. Clifford Older.

Mr. Sydney B. Williamson, of the well-known contracting firm of Messrs. J. G. White & Company, Limited, London, England, has been appointed Chief of Construction of the United States Reclamation Service, a newly created office. Mr. Williamson is the well-known Division Engineer of the Pacific division of the Panama Canal. Since the completion of Panama Canal he has been with J. G. White & Company, of London. He will spend the greater part of his time in the field, his particular function being to expedite construction work, and to secure the greatest possible efficiency.

Mr. H. M. Passmore has been appointed Secretary to the Ontario Public Works Department.

Mr. J. W. Pugsley is the new Secretary of the Department of Railways and Canals, Ottawa.

Mr. W. F. Gronau, Chief Sales Agent of the Dominion Bridge Company, Montreal, has been in Vancouver in connection with the Second Narrows bridge tenders.

Mr. W. A. McLean, Chief Engineer of Highways, and Commissioner of Public Roads for Ontario, was in Chicago last week fulfilling his part as presiding officer at the convention of the American Road Builders' Association.

Mr. G. G. S. Lindsey, K.C., of Toronto, President of the Canadian Mining Institute, delivered an address, "The Business Ethics of the Engineer," before the Engineering Society of Queens University, Kingston, on Tuesday, December 15th.

Mr. Samuel Hale, who for some years has been Manager of the Algoma Steel Corporation, Sault Ste. Marie, Ont., is about to retire from that office owing to ill-health. Mr. J. F. Taylor, President of the Company, will take charge of the operation of the plant.

Mr. W. F. Graves, A.M. Am. Soc. C.E., Chief Engineer of the Montreal Tramways Company, has been selected as one of a committee of three to make a valuation of the track property of the Detroit United Railways Company, for the Michigan Railroad Commission. Mr. Graves was formerly with the engineering staffs of the elevated and surface street railways of Chicago.

Convention News

The annual meeting of the American Society of Heating and Ventilating Engineers is to be held in the Engineering Society's Building, New York City, January 20-22. The Secretary is Mr. J. J. Blackmore, New York City. A further announcement regarding the convention will be published in due course.

In regard to the approaching convention of the American Society of Engineering Contractors, which—as already announced in these columns—is to be held in New York City on January 15th, the Secretary, Mr. J. R. Wemlinger, informs us that there will be an afternoon session for business purposes, and an evening session, which will be brought to a close by a banquet. The banquet will be enlivened by a number of entertaining features, including music and moving pictures. The Committee for Arrangements is preparing a report and further details will be given in a later issue.

The Society of Constructors of Federal Buildings are to hold their annual convention at Washington, D.C., January 4-6, as already announced in these columns. The Secretary, Mr. T. R. Maul, of Philadelphia, has kindly favored the Contract Record with the following additional particulars: The headquarters of the Society during the meeting will be at the Ebbitt House, and the meetings will be held at the rooms of the Washington Architectural Club. The opening session will be held at 2 p.m. on Monday, January 4, when reports will be received and various routine business carried out. In all there will be six sessions, two each day, devoted mainly to papers and discussions. On Wednesday there will be a dinner and smoker at the Ebbitt House. During the meetings of the Convention papers will be read or addresses made by the Hon. W. G. McAdoo, Secretary of the Treasury; Mr. Byron Newton, Assistant Secretary if the Treasury; Mr. Oscar Wenderoth, Supervising Architect; and various members of the Field and Office force of the Supervising Architect's Office.

Mainly Constructional

East and West—From Coast to Coast

The new town of Burlington, Ont., will expend $90,000 on sewer construction.

The Walkerville Roofing Manufacturing Company, Limited, Walkerville, Ont., has been incorporated with a capital of $60,000.

The ratepayers of Sarnia, Ont., are to vote next month on a by-law looking to the erection of a new city hall at a cost of $60,000.

At Calgary, work is to be started immediately on a trunk sewer estimated to cost $246,000. Mr. A. W. Ellson Fawkes is the engineer.

Tenders are about to be called by the Ottawa City Council for a new bridge, of the Bascule type, over Pretoria Avenue. The estimated cost is $120,000.

Brantford, Ont., ratepayers are voting next month on a by-law to raise $100,000 for the completion and extension of a water-works system now under construction.

The Letourneau College at Maisonneuve was destroyed by fire last week at a loss of $120,000. The building was owned by the Christian Brothers of Montreal.

Ridley Kennedy, Limited, is the name of a new firm with head office at New Westminster, B.C., incorporated with a capital of $10,000, to manufacture motor trucks and automobiles.

The London, Ont., City Council has authorized the immediate construction of sewerage works estimated to cost $14,000. This is with a view to relieving the unemployment situation.

The Taylor Engineering Company, with head office at Vancouver, has been incorporated with a capital of $50,000, to manufacture and deal in mechanical and electrical appliances and machinery of all kinds.

Large quantities of building material will be required for the new grain elevator which is to be erected at Vancouver at a cost of $1,000,000. The general contractors are Messrs. Barnett & McQueen, Vancouver.

The property and plant of the Imperial Cement Company, Limited, Owen Sound, which was advertised for sale recently, has been withdrawn from the market, the owners having made a satisfactory settlement for the continued operation of the factory.

The new school building which is being erected at Hochelaga, Que., has reached the roofing stage. The school is of stone and brick construction and will cost, upon completion, some $200,000. The architects are Messrs. Viau & Venne, and the general contractor is Mr. J. A. Duchocher.

Exterior work on the new Loyola College, which is being erected at Notre Dame de Grace, Montreal, at a cost of $400,000, is progressing satisfactorily. The building is of stone, of fireproof construction. The architects are Messrs. Peden & McLaren, and the general contractors are Messrs. Anglins, Limited.

At Highlands, Edmonton, the new building erected for the Public School Commissioners at a cost of $50,000, is nearing completion. The building is two storeys high, of stone and pressed brick construction. The architect is Mr. J. Turner and the general contractors are Messrs. Read, McDonald & Brewster.

The A. B. See Electric Elevator Company of Canada, Limited, are taking advantage of the dull days to completely equip a large elevator factory in the city of Montreal—where in future they will manufacture everything in connection with their elevators. This company will place large orders for machinery at an early date.

The decrease in building at Montreal and other cities and towns on the St. Lawrence is reflected in the tonnage of sand sent through the Lachine Canal. During the past season 65,713 tons went up the canal, a falling off of 15,775 tons; the quantity sent down was 68,644 tons, a decrease of 33,755 —the total decrease being 49,530 tons.

At the annual meeting of the Hamilton, Ont., Builders' Exchange, last week, the following officers were elected:—President, Mr. T. C. Pearce; First Vice-President, Mr. W. Murray; Second Vice-President, Mr. W. H. Dennis; Treasurer, Mr. J. Neil; Directors, Messrs. G. Metcalf, G. Hannaford, W. H. Yeates, Jr., W. Penny and E. R. Somerville.

Proposed Free Labor Bureaux

WITH the object of asking the Government to introduce a Bill for the immediate establishment of free Federal labor bureaux throughout the Dominion, a deputation interviewed the Hon. W. T. Crothers, Minister of Labor, at Ottawa, on December 14. The deputation included Messrs. J. E. Adamson, Secretary of the Builders' Exchange, Ottawa; F. Hawkins, Secretary of the Canadian Lumber Association; H. Mattice, representing the Ontario Confederation of Labor; and R. L. Werry, Secretary of the Builders' Exchange, Montreal. It was pointed out that such bureaux were in successful operation in England and the United States, and it was urged that the Canadian Government should try the experiment, if only on a small scale. It was also said that the present system was a scandal, and devoid of all co-operation. The suggested bureaux would supply a means of finding work for people of all classes. Wages had been forced down in every department, and Mr. Werry pointed out that in Montreal the labor situation, so far at any rate as the building trade was concerned, was disorganized. Government control would be a most important factor in preventing distress, and if the bureaux did not create work, at least they would be instrumental in finding it for those who wanted it. The deputation asked for a non-partizan commission to manage the bureaux.

Mr. Crothers' reply was not particularly encouraging. He said that labor bureaux would cost a very large sum, and the Government could not raise money for any project that was not imperative. At the present time lumbermen were able to get any amount of labor for the camps at considerably reduced rates, while the owners of the limits obtained these at comparatively low rates. He would place the question of the bureaux before his colleagues in the Cabinet.

Victoria Branch, Can. Soc. C.E.

At the annual meeting of the Victoria Branch of the Canadian Society of Civil Engineers, the following officers were elected: Chairman, Mr. D. O. Lewis; Vice-Chairman, Mr. H. W. E. Canavan; Treasurer, Mr. Frank C. Green; Secretary, Mr. R. W. McIntyre; Executive—Mr. A. E. R. Wilby and Mr. A. E. Foreman; Auditors, Mr. E. H. Harrison and Mr. H. A. Icke.

An interesting address was delivered by Mr. F. C. Gamble, who had been Chairman of the branch for two years. Mr. Gamble made a plea for united effort and said that the success of such bodies depended upon the extent to which members sacrificed their personal aims. He lamented the paucity of papers presented at the monthly meetings and deplored the fact that men with the ability and material to write on instructive subjects needed so much pressure in this regard.

A New Device for Tying and Supporting Reinforcing Bars

LEADING designers have long realized the necessity for a positive placing of the reinforcing steel, and usually detailed drawings show the theoretical position of the bars. For instance, the ordinary way of keeping the reinforcing bars from showing on the under side of the slab is to have a laborer raise the bars from the forms with his shovel blade, a hook made specially for that purpose, or to rest the bars on stones before concreting. Such methods rarely result in satisfactory work as there is no gauge to determine the final position of the bars. If they have been raised too high they lose some of their efficiency and if not raised enough the fireproofing qualities have been lost.

In order to insure that the bars are placed the proper distance from the face of the forms, metal clips are frequently used. These are made of a heavy weight and good quality of sheet steel. The accompanying illustrations show the Universal Concrete Bar Support and Tie, which supports and ties the reinforcing bars in their proper position. It is made for all kinds and sizes of bars.

The U Support-Tie is made from a single piece of metal stamped from heavy gauge steel, which has ample strength against crushing down under practically any load that can come upon it. The bottom edge of the tie is bent to form a flat foot and prevent cutting into the forms when used on flat slab construction. Due to the great strength and rigidity of this tie fewer of them are needed than of wire and the manufacturers inform us that they recommend one U-Support where two wire intersections are called for. The standard height of leg is ¾ in., being measured from the bottom of the lower bar to the form. They can also be had in any length leg from ½ in. up.

The use of this clip eliminates having to untangle wire, straightening straps and placing of wedges. An ordinary claw hammer clinches the tie in place. For those builders dependent on the ordinary run of day labor for placing their steel, the manufacturers furnish a Clincher which clinches the tie in place at one operation.

The U-Truss Support-Tie is for use where the clearance is more than two inches. For the trussed portion of the bars in flat slab construction and in bridges, viaducts, etc., it insures the steel being in its proper position.

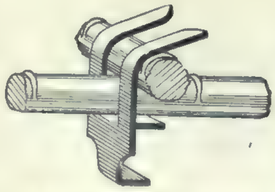
These Support-Ties are made by the Universal Stamping Company, Limited, Strasburg, Lancaster County, Pa., and are handled in Canada by Mr. R. J. McLean, 800 McGill Building, Montreal.

Opening of the Armstrong-Whitworth Plant at Longueuil, Que.

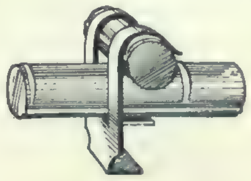
THE new plant of Messrs. Armstrong-Whitworth of Canada, Limited, at Longueuil, which was opened recently, represents an expenditure of $1,250,000. The layout and construction of the works, which has been under the direction of Mr. M. J. Butler, has been in progress for some two years. The company will employ a large force of skilled workmen in the manufacture of the highest grade of steel goods. The area of the property owned by the firm at Longueuil is 250 acres, extending down to the river front. Steps have been taken to secure the dredging of the river, so as to permit of the company's landing supplies and shipping their output at their own wharfs. The floor area of the units now at work covers 65,000 sq. ft. At present about 150 men are at work, but this number will soon be increased to 500. Expert steelworkers are being brought from Sheffield and other cities.

The opening of the works, which was performed by Mr. Geo. D. Foster, K.C., vice-president of the firm, was of a ceremonial character in keeping with the occasion. After the opening a number of interesting addresses were delivered. Among these was one by Mr. M. J. Butler, who told something of the achievements of the parent company in Great Britain and foreshadowed the possibilities of the Canadian establishment.

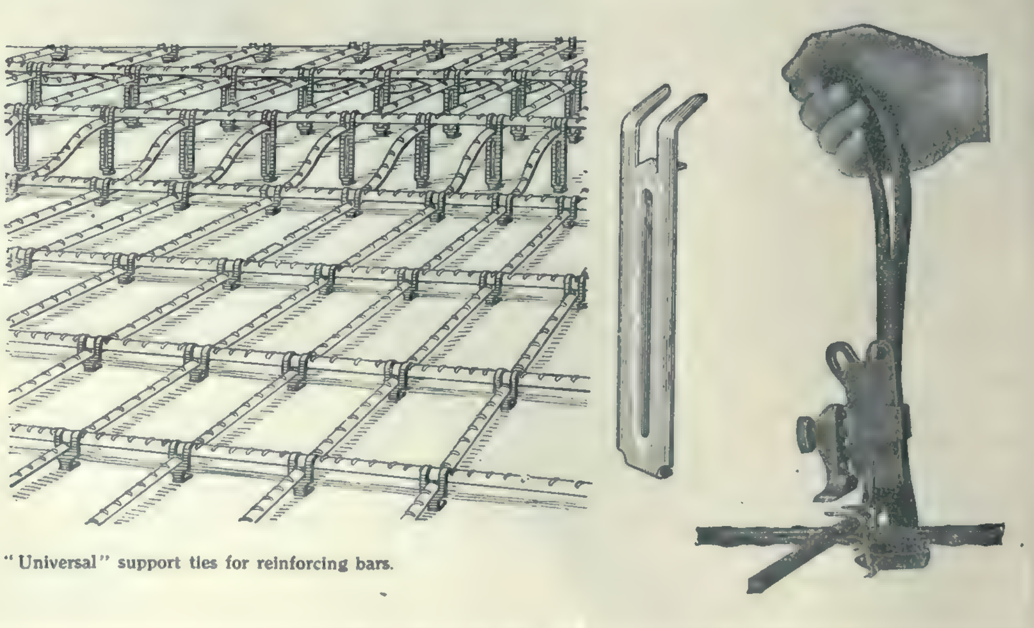
Among those present at the opening were: Mr. W. P. Ladd, Works Manager, St. Lawrence Bridge Company, Limited; Mr. John Russell, Canadian Explosives, Limited; Mr. W. J. Johnson, Superintendent, Canadian Car & Foundry Company, Limited; Mr. E. B. Tilt, Engineer of Tests, Canadian Pacific Railway Company; Mr. P. L. Miller, Manager, Canadian Vickers, Limited; Mr. J. A. Johnson, Superintendent, Steel Company of Canada, Limited; Mr. Geo. Cuttle, Steel Company of Canada, Limited; Mr. F. A. Smith, Works Manager, Canadian Steel Foundries, Limited; Mr. G. H. Duggan, Manager, Dominion Bridge Company, Limited; Mr. Jos. Waldie, Manager, Canadian Tube & Iron Company; Mr. D. Swinton, Superintendent, Canadian Car & Foundry Company, Limited.



Tie in place ready for clinching



The tie clinched



"Universal" support ties for reinforcing bars.

ESTABLISHED 1886

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and Engineering Review

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Alphabetical Index of Advertisers
Page 18

Vol. 28 December 30, 1914 No. 52

Principal Contents

Page
The Old Year and the New ... 1563
Lessons from the Edison Fire ... 1564
Definite Expression in Architectural Detail ... 1565
Stories of Great Engineers ... 1566
Olympia Hotel, Winnipeg—Details of Design and Construction ... 1567
The Behaviour of Reinforced Concrete in Fires ... 1568
Status of Air Ozonation ... 1569
Slag as an Aggregate in Concrete ... 1570
Fuel Oil and Its Application ... 1572
Preventing Odors in Refuse Disposal Plants ... 1573
Design, Construction and Detailed Costs of the Richelieu River Bridge, Lacolle Junction, Que ... 1574
Concrete Road Construction ... 1577
By H. J. Kuelling
Examples of Estimating Methods Practised by English Contractors ... 1579
Concreting in Freezing Weather and the Effect of Frost Upon Concrete ... 1582
By J. Hammersley-Hennan
B. C. Engineers in Session at Victoria ... 1583
Personal Mention ... 1584
An Interesting War Talk ... 1585
Constructional News ... 1586
Sewage Pumping Equipment at Chilliwack, B.C. ... 1587

The Old Year and the New

"All things must change
To something new, to something strange."

We are leaving Nineteen Fourteen behind and standing on the threshold of the New Year. To some of us in the constructional world the old year has brought a fair measure of prosperity, to others disappointment. In retrospect we are divided, but in prospect we are one. We have a common interest in the Year of Grace Nineteen Fifteen. We hail it with acclamation because there is every reason to believe that it will be a happier and better year than its predecessor. Nineteen Fourteen has brought wars and rumors of wars, great national trials and financial depression. Nineteen Fifteen must witness improvement. It cannot register further decline.

We have arrived at that stage of combat when the nations are showing reticence in the matter of encouraging the slaughter-house policy of the madman of Europe. The allied armies must go on with their task and reduce to complete submission the most treacherous and menacing foe that the cause of civilization has ever known; but the clamour for war is subsiding, and the task is becoming easier as time goes by and the resources of the enemy become exhausted.

Such considerations as these should give us fresh heart for the business of the coming year.

In inditing the final paragraphs of the editorial chapter of the old year we would impress upon our readers the argument that we have adduced in a number of previous articles, namely, that **we have the strongest reasons in the world for inducing capitalists and financiers to go ahead with constructional projects. Never in our generation will there be a time when more favorable terms can be made with manufacturers, supply dealers and contractors.**

One of the particular reasons for the reduction in the price of building material at the present time is the disposition on the part of the manufacturer and dealer to eliminate profit as far as possible in order to encourage building operations. Only a week or so ago at a meeting of a certain class of manufacturers in Montreal, it was decided to reduce prices almost to cost and extend terms to the limit. This disposition is not peculiar to one class of manufacturer. **In every line of material the supply man is willing to extend terms to encourage constructional projects where the credit standing of the purchaser warrants it.** There have come to our notice cases where firms which formerly insisted upon thirty days are now willing to extend their terms three or four months where they consider the purchasing parties "good risks."

Not only this, but, as we have pointed out before, the labor situation has changed materially and **there is now a surplus of all classes of labor.** Another point is that if real estate prices have not been affected to any great extent by the depressing incidents of the last few months, **lots are certainly available for purchase on better terms.** And generally, the whole constructional fraternity is working together to build up business and provide employment.

A Montreal correspondent of this journal, estimating the effect of these developments, averages the general reduction in building material anywhere from 20 to 25 per cent. on the prices obtaining six months ago.

So that with favorable opportunities of entering upon the next constructional season, and with hard facts to back a campaign for a bigger, brighter and better year, we hail the advent of Nineteen Fifteen.

In a sane, well-balanced confidence of the Empire's might and right we are justified in believing that before another twelve months this unjust war will have become only a nightmare of the past, and that Canada, with the rest of the Empire, will have entered upon a period of unexampled prosperity.

This is what the New Year has to offer. And so it is with all sincerity and with complete assurance in the future that we wish our readers a Happy and Prosperous New Year.

Lessons from the Edison Fire

It may be ventured that no occurrence of the kind in recent years has attracted more attention in constructional circles than the fire early this month which destroyed the greater part of the Edison plant at West Orange, N.J.

The fire started early in the evening, in the Film Inspection Building—a one-storey sheet iron structure located in about the centre of the plant. The contents of this building were highly inflammable, and the fire spread rapidly to the adjoining buildings. The principal reasons assigned for the extent of the disaster are interesting in view of the manner in which an examination of the structures showed the small damage sustained by the concrete buildings. The experts employed to make a survey after the fire reported 87½ per cent. of the concrete construction in first-class condition. The damage was attributed to:—(1) the highly inflammable character of the contents of the building; (2) the inadequacy of the water supply; (3) the fact that the window openings were fitted with wooden sashes and plain glass; (4) lack of fire walls; (5) lack of automatic sprinklers.

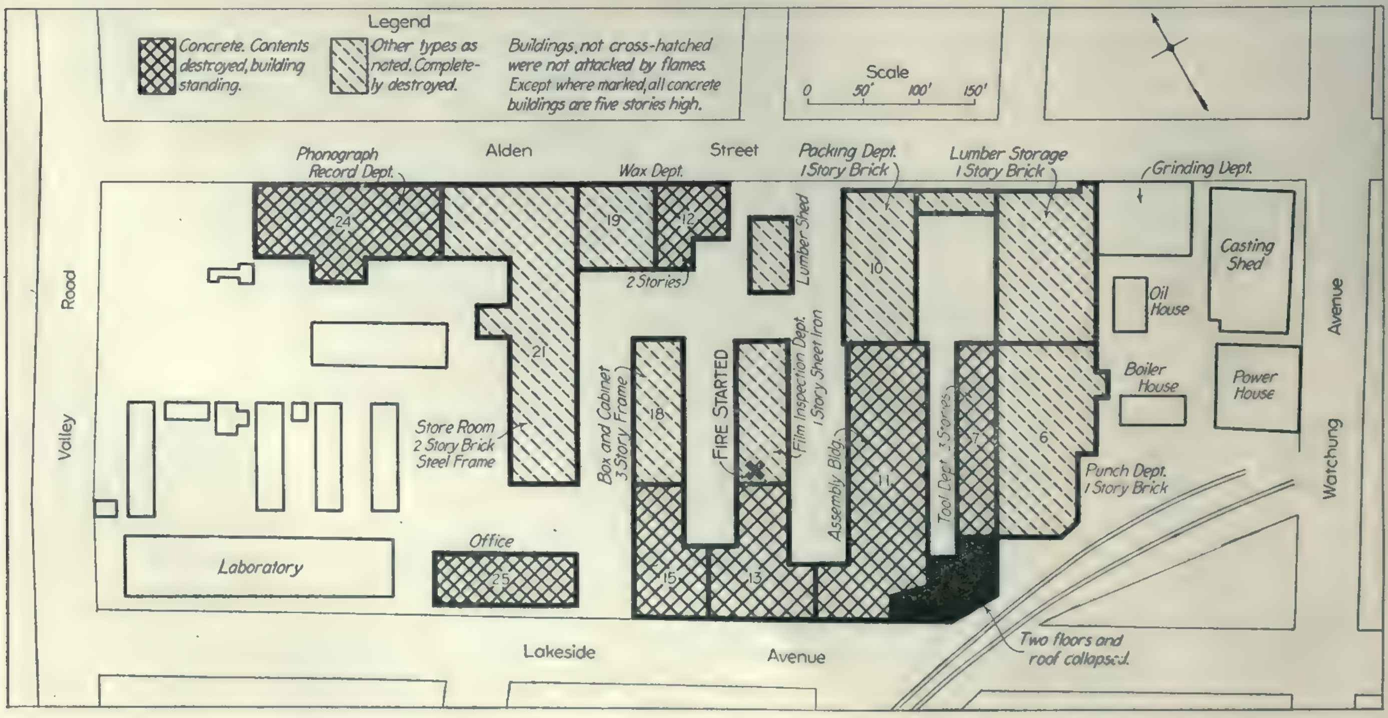
The plan reproduced herewith shows the location and type of the buildings at the plant. With the exception of certain sections in Buildings 24, 15 and 11, the concrete buildings were found in good condition. They were all standing, and the salvage of the contents will be large. This is held in marked contrast to the brick structures, where the collapse of the buildings resulted in heavy loss of contents.

The following comment on the lack of proper fire-prevention measures is made editorially by the Engineering Record:

"While chief interest would seem to centre in the performance of the concrete buildings, the most important conclusion is a costly verification of one of the fundamentals of fire protection practice. This conclusion should be preached from the house-tops—that when structures are exposed to fire hazard from without it is folly to place one's trust in "fireproof" buildings fitted with wooden window sash and plain glass. The ruin at West Orange, thrown in relief by being linked with the great inventor's name, preaches that lesson to the matter-of-fact executive more strongly than all the fire-prevention documents ever written. Here was a plant with closely spaced buildings, all of them without the fire-protection provisions which long experience has demonstrated to be essential for the safeguarding of such structures. Moreover, there were no fire walls to prevent the spread of the flames from one adjoining building to the next, and none of the buildings were equipped with automatic sprinklers. The concrete buildings were considered "fireproof," but can be called so only by courtesy. They were not fireproof, except in the sense that they themselves would not burn. They were virtually concrete stoves, with tinder at every window inviting the application of the torch.

"As for the performance of the concrete buildings in so severe a test, one can happily report that they came through very well. It is safe to say that four of the seven are in their entirety usable. In two of the remaining buildings the damage is local, affecting parts of four floors, while in the third the columns in the first floor are in very bad condition.

"Of interesting questions raised by the fire there are many. Two are especially pertinent. Was the failure to use ties or hooping around the reinforcing responsible for the damage to columns where the fire was unusually hot, as, for example, in the basement of building 11, where the expansion of the rods seems to have forced off the column corners? Are the severity and duration of the fire sufficient to account for the


Legend
Concrete. Contents destroyed, building standing.
Other types as noted. Completely destroyed.
Buildings, not cross-hatched were not attacked by flames. Except where marked, all concrete buildings are five stories high.
Scale
0
50'
100'
150'
Alden
Street
Phonograph Record Dept.
Wax Dept.
Packing Dept. 1 Story Brick
Lumber Storage 1 Story Brick
Grinding Dept.
24
19
12
2 Stories
Lumber Shed
10
Casting Shed
Oil House
Road
21
Store Room 2 Story Brick Steel Frame
Box and Cabinet 3 Story Frame
18
FIRE STARTED
Film Inspection Dept. 1 Story Sheet Iron
Assembly Bldg.
11
Tool Dept. 3 Stories
7
6
Boiler House
Power House
Punch Dept. 1 Story Brick
Avenue
Watchung
Valley
Laboratory
Office
25
15
13
Lakeside
Avenue
Two floors and roof collapsed.

Location and type of buildings at the Edison plant.

column damage in certain sections or is the theory, advanced by the plant officials, that their failure was due to the water thrown on them while hot necessary to account for the destruction? These questions are open to argument, but as to the second we believe that the water played a critical role. Without this conclusion the strange localization of the column failures seems inexplicable, for there is reason to believe that there was very intense heat elsewhere than in the sections suffering maximum damage.

"It will be natural to use the disaster for making comparisons between different types of construction, and opinions as to the efficiency of the concrete structures under such conditions will likely be influenced by prejudices for or against this type. To the Engineering Record, however, certain conclusions, based on alternative premises, seem evident. If the untied column rods played an important part in the failures, other fireproofed types may have come through just as well. If water was the chief factor, then any other type than concrete, under the conditions which obtained in the ground floor of bulding 11, in the southeast corner of the same structure, and in the third floor of building 24, would have been on the ground, with a very much larger contents loss than in the case at West Orange. Of course the failure in 24 might have been confined to the west wing, and that in the corner of 11 to the particular section in question.

"Regardless of these views or those others may hold, all can agree that no structure, no matter what the type, should be called upon to meet such a test. The fundamental question is not as to the type that makes the best stove for inflammable contents, but what methods will prevent the spread of the flames. Fire-resisting window and door construction, fire walls and, above all, sprinklers furnish the answer."

Definite Expression in Architectural Detail

From the Building News (London)

FORM, as it develops under hammer and chisel, may typify the emergence of definite theme from nebulous idea. In like gradual manner line and lineament are evolved in the brain of the designer. We grope blindly for clear expression of that which we do not at first clearly comprehend. A hazy first notion becomes defined only as we strive to express our sentiment—as we bring the subject-matter of our thought into better and better focus. All that may reasonably be termed novel in design is no doubt produced in this way, since invention is often slow, step by step, and laborious.

In all these efforts of the brain, that which we are in reality striving to attain is definite expression—the clear-cut and logically correct transcript of mental imagery. We seek to place, with pencil on paper, the fleeting idea. We shall be well advised to exercise patience in attaining this. It will be well thoroughly to grasp and fully interpret our idea. The hasty transference of ill-considered design to solid stone will mean loss of definiteness. Some of the shadowy vagueness of our first mental conception will inhere. That which we should earnestly seek is definition. We desire the intelligible and apparent—meaning, import and significance.

It has been said that curiosity is the real overmastering passion. We are all continually asking—subconsciously, no doubt—"What is it?" In direct and indirect ways we constantly put this question to ourselves. It is ever present, as we encounter novel objects. For this reason, we must assume that the matter greatly concerns design. We should at all times remember the promptings of curiosity, and by no means dismiss the subject by counting it an ignoble passion. We should recognize the position, and remember that anything ill-defined, from carelessness or lack of sufficient thought and consideration, causes perplexity and leads to offence. We should endeavor so to present our architectural ideas that the meaning and nature of the object are never in doubt; for that which we do not, or cannot, understand or clearly comprehend engenders mystery. In this way we may be impressive, and even awe-inspiring; but since, in architecture, we seldom need to produce the mysterious, definiteness of expression, obvious intention and meaning, should be our aim.

There are few more praiseworthy aims in practical architecture than an endeavor to give correct and clear expression to everything added to plain building as an ornamental accessory. We know that this general principle is at the root of successful architecture as an affair of organic constructional parts; we must hold that a similar effectiveness characterises architectural ornament that has fitting and definite expression. It is the meaningless, purposeless scroll, or curve reflex, representing nothing definite, based on no prototype, referring in no way to objects found in nature, that fails by virtue of its absence of definite expression.

If we examine ourselves, no doubt we shall find we all like to recognize, clearly, that, say, an oak or a vine-leaf is intended. We like and we admire definite expression, faithful observance of characteristic of this or that natural prototype, which the designer has taken as a model, or used as a motif. Where very highly-conventionalized ornamentation is concerned, our rule may need a little latitude in application. Yet is it to be noted that we cannot truly conventionalize, excepting as we exalt and aggrandize characteristic, and instil more of the essential spirit of the object conventionalized. If we make any one chance leaf or flower a model, we must needs produce a less characteristic representation of the genus than when we take as a model an ideal form conceived as the average of numbers of such leaves or flowers. In true and masterful conventionalizing, the spirit of the natural object is enshrined, so to say, in the ornament. By thus considering our proposition, that definiteness and ready-recognisability are most desirable attributes in architectural ornamentation—to employ a not very happy, if common, expression—we should arrive at the conclusion that in conventional, floriated enrichment, having real, natural, basic prototype, a high degree of definiteness is required in design, and is, by the very nature of the process of true conventionalizing, assured.

The belief that definiteness of expression is essential in good architectural enrichment will, we believe, be established on all grounds of inquiry. Besides the sweet reasonableness of the principle, we shall find that the measure of definition is closely related to the amount of skill and thought bestowed upon the work; and that carelessness and haste, and, obviously, ignorance, are at the root of that indefinteness of expression and lack of intent and purpose in "decorative" device, which we too often find in contemporary architecture. We curve and reflex and re-reflex, and let things go at that. It is so easy; but to produce a truly sculpturesque acorn is not easy.

When we ask that question: "What is it?" we shall find, as a rule, that the readiness of answer corresponds to the amount of care and thought with which the decorative device has been executed. If we desire character in enrichment, we must go to Nature for some prototype, and let oak-leaf in wood, or stone lily, show obvious relation to this. We have, then, Nature as guide; and, truly, in decorative design, we must appeal very directly to natural form for motive and inspiration. We have no other guide, no other compass, here.

Pure geometrical ornament we may view in a somewhat modified light, although geometry is obviously natural enough. We might classify all necessary architectural enrichment and ornamentation into the quasi-natural, or "naturalesque," the more or less conventional, and the wholly geometric. In the former we must include all frankly realistic carving, the best work in which is saved from the charge of ignoble imitation by the instinct of the sculptor who imparts the sculpturesque attribute. Our principle of endeavoring to impart the fullest and most characteristic form and lineament warns us against mixed ornamentation—vegetation growing out of animals, and like evidence of debased thought in design matters. Certainly, if we encounter an object of supposed value as architectural decoration, half-tree, half-animal, we might pertinently ask: "What is it?"

All naturalesque, conventional, and geometric forms are, in reality, based on nature. In seeking to impart that fitness for architectural embellishment which differentiates slavish imitation from true ornament, we should endeavor to give to the first class of ornamentation high resemblance to prototype, short of missing that sculpturesque quality that lifts the work out of mere copyism. In highly conventionalized ornamentation, we should rather seek to instil the spirit of plant life. Taking such a decorative device as the Grecian honeysuckle, we see that it is a highly-conventionalized ornament, and over and above the special beauty of the flower that forms the motive of the design, the general disposition and arrangement of the parts displays vigour and vitality. The definite expression sought to be expressed in conventional form is, in major part, the essential grace and beauty of plant life.

We cannot but conclude that all decorative form should have reference, basically, to something natural —existent and created, or, as in the case of geometry, co-eternal. Unless this statement is carefully weighed, it may be doubted. It will, on mature consideration, we think, be found substantial, and acceptable to all but those who see beauty in meaningless scrolls, and purposeless curve and reflex. He who imagines that he can evolve true and beautiful ornament from his inner consciousness without reference to natural base or prototype—motif—practises self-deception, is less a true artist than the savage who incises roughly, simple natural objects on his door-posts, or than Palaeolithic man rudely drawing the mammoth on fragments of tusk.

Let us commence our work by asking ourselves the question: "What is it?" Such a practice followed in actual process of design might tend to rid us to some extent of the fearsome horrors of rococco ornament, and of the senseless, double-ended, curved and reflexed bone-like objects that seem an obsession in the minds of so many so-called "ornamental" draughtsmen.

Stories of Great Engineers

(From The Surveyor)

THERE is some consolation in the fact that, though the pay of the rank and file of civil engineers is still very vile, it is vastly better than it was in the days of yore—at least, in the cases of consultants of repute. It is recorded that John Smeaton was satisfied to be paid two guineas for a full day's work, and this was the man of whom Robert Stephenson spoke as "the engineer of the highest intellectual eminence that had yet appeared in England," and "the greatest philosopher in our profession that this country has yet produced."

Rennie's bill against the Manchester Water-works Company for his year and a half's advice was only £159, his charge to them for a whole day's labor being six guineas. The Ordnance Department he charged seven guineas a day, and General Brownrigg, the head of the department, complained, saying it was equal to the pay of a Field Marshal. "Well," replied Rennie, "I am a Field Marshal in my profession, and if a Field Marshal in your line had answered your purpose I suppose you would not have sent for me!" "Then you refuse to make any abatement?" "Not a penny," replied the engineer—and the bill was paid.

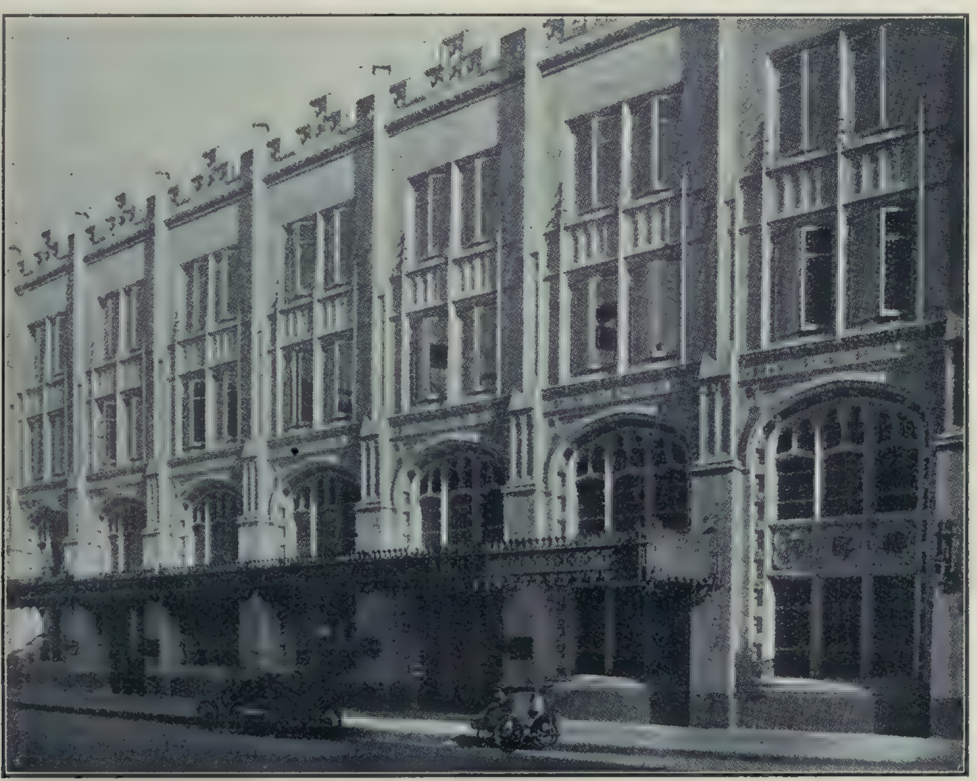
Have we any leading engineers as versatile as John Rennie? During his college career he read Emerson, Switzer, Maclaurin, Belidor, and Gravesande, allowing neither pleasure nor society to divert him from his studies. As a relaxation he learned French and German, and was shortly able to read both with ease. His recreation was mostly of a solitary kind, and having a taste for music he acquired considerable proficiency on the flute and the violin, and even went so far as to buy a set of bagpipes and learn to play upon them. But when he left Edinburgh the extensive nature of his engagements so completely occupied his time that in a few years flute, fiddle and bagpipes were laid by altogether.

Among John Rennie's earliest pieces of workmanship was a fleet of miniature ships, which he made when he was only about ten years old. Shortly after, by the advice and with the assistance of his friend Meikle—who took as much pride in his performances as if they had been his own—Rennie made a model of a windmill, another of a fire engine (or steam engine), and another of Vellore's pile engine, all displaying a considerable amount of manual dexterity. According to Dr. Smiles' "Lives of the Engineers," at least sime of these early efforts of the great engineer's boyish genius were still in existence some ten years ago. It would be interesting to know if they still exist, and, if so, where.

The total value of the stone produced in the United States in 1913 was $83,732,995, as compared with $78,193,220 in 1912, an increase of $5,539,775, or 7.08 per cent. The year surpassed all previous years in the value of granite, trap rock, sandstone, marble and limestone, increasing 8.17, 22.88, 2.02, 1.08, and 5.49 per cent. respectively over the value for 1912.

A New Winnipeg Hotel with Up-To-Date Constructional Features

IT is claimed for the new Olympia Hotel at Winnipeg that it contains some of the finest architectural work in Western Canada. At least, this is one of the features which entitles the building to special mention. The hotel, which is of steel construction throughout, with hollow fireproof tiling, is four storeys high, with basement and sub-basement, and contains accommodation for two hundred and fifty guests. The exterior finish is executed in terra-cotta, with gray brick facing the lanes and light wells. The fire escapes and stairways are enclosed in fireproof compartments opening into the corridors through metallic doors with wired glass. The architectural style follows the Gothic and Renaissance. The material used is a soft grey terra-cotta, which starts from the polished concrete base. The flat walls of the upper storeys terminate in a line of battlements deeply carved and ornamented. A feature of interest is the massive marquise which extends across the front and sidewalk, the whole structure being of cast iron and glass.



Attractive exterior of the Olympia Hotel, Winnipeg.

The rotunda and lounge are entered from the north vestibule, which is finished in oak and stained glass. The ceiling, which is heavily moulded and stencilled, is supported by massive pillars rising from a base of grey marble. The walls are of buff Caen stone, rising above a wainscotting of Tavernell marble, with floors of a colored variety of Tennessee marble. Here Gothic influence is seen in the arched openings, the heavily ornamented ceiling, the hammered brass fixtures and the stained glass doorways.

The commercial atmosphere of the routine offices on the ground floor is relieved by the excellent taste in woodwork and the skilful planning. The public telephone booths are of inlaid walnut, and are finished with stained glass doors and windows.

Adjoining the lounge is the ladies' reception room, dining-room, bar, and service department. The main stairs, which are of marble, lead to the mazzanine hall on the second floor and to the grill room in the basement.

The guest rooms are commodious and well lighted. The private baths adjoining are fitted with porcelain fixtures, while the floors are finished with a composite white tiling. The approach to the mezzanine hall is by a staircase of Tennessee marble leading from the rotunda. The walls of the hall are panelled with a tightly stretched fibre covering. A heavy railing of bronze-stained oak separates the panels from the deep plaster frieze. The ceiling is arched and ornamented with a continuation of the sidewall decoration.

The design of the tea room follows that of the mezzanine hall. The beamed ceiling is supported by large pillars. Natural lighting is obtained through broad arched windows and skylights.

The dining-room, which is two storeys high, follows the Renaissance design. Here there are tapestried pillasters, with silk cord side-light fixtures suspended therefrom. Light is furnished through panels of stained glass.

The interior of the buffet is a particularly fine example of Gothic. Like the dining-room, it is two storeys in height. The walls west and south are faced with buff Caen stone rising above a base of polished marble. Iron lanterns are suspended from the heavy oak rafters. The appearance of the room is enhanced by a series of mural panels depicting Norman scenes. The floor is of red tile.

The walls of the grill room are finished with tapestried brick. The ceiling is done in light cream with skylights of the same tint. The floors are of red square tile and black mortar. The grill is separated from the lobby and coat room by an oak door.

Power is so cheap in Winnipeg that it was not considered advisable to install a generating plant. There are connections, however, with both the city lighting and street railway power, which will prevent inconvenience in the event of damage to the regular sources of supply.

In the basement there are large boilers of the Scotch dry back type. These are internally fired by Morrison suspension furnaces. There are three of these boilers, each developing 150 h.p.

The hotel has its own wells, which are drilled to bed rock. Water is stored in large tanks from which it is distributed through the water softeners, the domestic supply tank, and the high pressure tank in the pump house on the roof. Owing to the fact that the basement extends below the level of the city sewers, pneumatic and electric sewage ejectors of a noiseless type have been installed.

Dining Room, Olympia Hotel, Winnipeg.

The cost of the building proper is estimated at $600,000, and with furnishings at $1,000,000. The general contractors were the Carter-Halls-Aldinger Company, Limited, Winnipeg.

Blasting frozen bulk freight, such as sand, clay, rock ballast or ore, is recommended in the October issue of the DuPont Magazine. The following directions are given: Use a slow-acting dynamite in small quantities, say one-fourth or one-half of a 1¼ x 8-in. cartridge per charge. Make a hole with a crowbar in such material as broken stone, and with an auger in sand or clay. The charge should be not less than 2 or 3 ft. from the side or bottom of the car. Tamp the hole when loaded and fire the charge preferably with an electric detonator, although a blasting cap and fuse may be used. It is stated that the material may be opened up in this way without damage to the cars and without throwing the material.

An interesting incorporation at Montreal is that of the International Lime Company, Limited, which is capitalized at $200,000. The incorporators include Messrs. W. K. McKeown, Henri Lacerte, E. A. Barnard and G. E. Chart, all of Montreal.

The Behaviour of Reinforced Concrete in Fires

THE ability of reinforced-concrete construction to resist severe fires has been demonstrated in three recent conflagrations, at Kingston, Ont., Youngstown, Ohio, and Kansas City, Mo. In each case the heat was intense and in two of the fires the adjoining structures were destroyed completely.

At the plant of Davis & Sons' Tannery, Kingston, there were two buildings side by side, one a Kahn-system reinforced-concrete structure, the other a brick dwelling with interior wood construction. These two buildings were joined at two points toward the end. The fire completely demolished the brick building, while the reinforced-concrete structure in the midst of the flames was practically uninjured. So intense was the heat that the wire glass in the latter building was melted to a liquid and hung like icicles in various places. The wooden water tank on the top of the structure was reduced to a mass of chars, but has since been replaced. All that remained of the brick building, which was four storeys high and filled with leather and machinery, was a mass of scrap iron, steel and brick.

Buffet, Olympia Hotel, Winnipeg.

There were also in the fire an engine house and a leach house. The brick walls and wooden roof of the engine house were entirely destroyed. The leach house, which has concrete walls and a wooden roof, shows the concrete walls still standing, while the interior was completely gutted.

In the fire of J. R. Thomas & Sons' wholesale warehouse, Youngstown, Ohio, the heat was particularly intense, as the contents were of a highly inflammable nature. The building was about 100 ft. square and six storeys high, and at the time of the fire was well filled with stock.

Two carloads of matches stored at one point of the sixth floor under the roof were reduced to a mass of ashes. These matches burned intensely for three hours, during which the temperature was continuously at about 1,700 deg. Fahr. Careful examination of the reinforced-concrete roof above this point showed practically no damage. The bottom of an occasional terra-cotta tile was broken off, but this was readily repaired by metal lath, and plaster.

The cause of the fire, although not exactly known, is believed to have been due to the explosion of rat poison, which simultaneously started the fire on the second, fifth and sixth floors. The explosion was of such violence as to blow out the wall on the south side of the building on the upper two floors, but no damage was done to the reinforced-concrete construction.

The floors and roof consisted of a combination of reinforced concrete and hollow tile. In this system the rows of terra-cotta tile were separated and supported by concrete joists reinforced with Kahn trussed bars. This reinforced-concrete floor was supported on structural steel beams and columns incased in concrete. The floors were designed for a live load of 250 lbs. per square foot.

On another part of the floor brooms were stored, some of them being hung from the ceiling and others resting on the floor. So intense was the heat that the handles of these brooms were entirely consumed, but the floor construction showed no signs of damage. Paper bags were piled up to the ceiling on one part of the second floor, and burned fiercely until entirely consumed, yet the only damage to the floor above was to the bottom side of a small area of hollow tile. That the floor iteslf was not weakened by this intense fire is shown by the fact that above this portion were stored boxes containing canned goods weighing about 300 lbs. per square foot. There was no apparent sign of deflection of the ceiling below.

After the debris resulting from the fire had been cleared out, in order to ascertain whether the floor had been weakened in any way by the fire, a test was made. A load of 300 lbs. per square foot was placed over the location where the fire had been most intense, and the total deflection of the floor was less than 1-16 in. In this way it was determined that the floors had not been weakened and that they will not have to be replaced. The only repairs required are a slight patching up. The entire concrete construction can, it is stated, be repaired at the expenditure of a few hundred dollars, although the damage to the stock amounted to more than $200,000.

A conflagration occurred recently in the First Christian Church Annex, Kansas City, Mo. The first and second floors of the annex were of reinforced concrete, steel Floretyle construction of the Trussed Concrete Steel Company being used. The upper three floors were constructed of cast-iron columns, steel beams and wooden joists. The building was in course of construction at the time of the fire, and the Hy-Rib ceiling had not been plastered on the under side. Hence the Floretyle construction was subjected to a more severe test than would be expected in a completed building.

The upper three floors of the annex and the church itself were destroyed by the fire. In addition to this the first floor was divided into a number of rooms by wooden partitions which burned up completely, but this additional heat did not affect the construction.—Engineering Record.

A total of 19,881,714 cross-ties were purchased by the steam and electric railways of Canada during 1913, according to a Forestry Branch Bulletin. In 1912, a total of 21,308,571 ties were purchased. Of the 1913 total, 39.1 per cent. were of jack pine; 12.3 per cent. white cedar; 12.2 per cent. Douglas fir; 6.2 per cent. western larch; 6 per cent. hemlock; 5.7 per cent. hard pine; 4.9 per cent. oak; 4.4 per cent. tamarack; and small percentages of western hemlock, spruce, chestnut, red cedar, red pine, beech, birch, maple, elm, ash and cherry.

The Status of Air Ozonation

AT a recent meeting of the American Society of Heating Engineers, Mr. M. W. Franklin presented a paper on the above subject, and in the discussion which followed an interesting comment was made by Professor J. D. Hoffman, of the University of Nebraska.

The Professor based his remarks on the following statements which the author had made in his paper:—

"According to the modern theory of ventilation, the only baneful factors in 'vitiated' air are heat, moisture and odors."

"It has been shown that in the worst cases the available oxygen is far in excess of the demand, and that CO_2 is harmless in concentration likely to be met. The conviction once prevalent that organic 'crowd poisons' were the guilty factors likewise has been abolished."

"The most recently demolished belief was that bacteria existed as a menace in re-breathed air."

"The modern practice of ventilation, then, clearly is concerned only with absorbing the almost invariable quantity of heat produced per capita of room occupants, of removing the moisture transpired, and of destroying the odors generated, etc."

Professor Hoffman remarked that, according to these quotations, there was no question of doubt concerning the wholesomeness of respired air if it was only kept at the proper temperature and humidity and kept free from odors. In imagination, let two men be taken, of equal normal health qualifications, except that one had lost the sense of smell. These men were subjected to an atmosphere heavily charged with offensive odors, and the question was whether the man with the normal sense of smell would receive the greater injury.

Certainly, odors were not harmful; they merely indicated the trouble. Personally he (the Professor) was inclined to regard the sense of smell as an easily-applied proof of the stagnation of the air, comparable in a way with the CO_2 test, which was a proof of the amount of fresh air supplied and the distribution of the air in the room. As to eliminating odors as being merely unpleasant and not harmful, it might be asked "How about temperature and humidity?" Surely heat and water were not baneful factors or harmful to the human body, except as taken in extraordinary amounts.

No person contended that an otherwise pure atmosphere, having less than normal oxygen or more than normal CO_2, would be fatal or immediately harmful, although its subtle influence upon health by long continued applications to those conditions had still to be proved.

Referring to "crowd poisons," Professor Hoffman said that, even if able to define them, was enough known about them to be sure there were no such poisons? Was it conclusively proved that bacteria did not exist in respired air? The careful observer would insist that judgment upon those most vital points should be exceedingly deliberate.

To subject persons in normal health to bad air conditions for a few hours or days, and then draw conclusions as to the permanent health effects, was not good logic. Because persons might stand certain unsatisfactory surroundings for a brief period without apparent harm did not argue that the same persons could continue this indefinitely.

Concerning bacterial and germ poisoning, there were many convincing object lessons to be seen around them. In a family of his acquaintance, one member contracted tuberculosis in an unhealthy trade, and lay for some time before being taken. At this time, all the other members of the family seemed in normal health. But within a couple of years two more were taken in the same way, although the disease was contracted differently from the first case. The remnant of the family was advised to move to other quarters, and so far as he had learned, no more were taken. The sentiment was expressed that leaving the old home, which no doubt was thoroughly filled with the germs of the disease, saved their lives.

Another case which exhibited conditions fully as striking was called to his attention. In a fraternity house one of the boys contracted tuberculosis, and, while sitting by himself, used one of the discarded heat stacks as a spittoon. After his death one after another of these splendid fellows gave up their lives until the fraternity was completely demoralized. After the cause of the scourge was learned, and a move was made to other quarters, everything was satisfactory. Hundreds of such cases could be cited.

Of all the delicate machinery enclosed in the human body no part had more effect upon the general health than the incinerator or purifying plant termed "the lungs." When these were not supplied with air of proper quality or amount, or when they were thrown out of service by disease, stagnation ensued.

The Professor went on to say that he was convinced the author of the paper under discussion did not wish them to understand that the wholesale destruction of former precedents and ideals in ventilation, as specified by him, was unconditionally recommended. As to the first quotation, the word "baneful" meant having poisonous qualities, the state of being harmful or destructive, etc. The author had stated "So far as is definitely known, the value of ozone in ventilation is not due to any beneficial effect upon the human economy, but to the circumstance that it destroys much that may be objectionable or harmful in foul air, etc." The whole value of his paper was based upon the fact that ozone had the power to destroy bacteria and harmful substances floating in the air, and since he (Mr. Franklin) recognized ozone to be a powerful germicide, he recommended it as an accessory to the modern ventilating system.

The Professor remarked that he had no criticism to offer upon this view of the subject except to say that the person not accustomed to inhaling ozone had better begin with very small amounts and increase the dose gradually. In experimenting with an ozonator he had found it necessary to limit its use, because of the influence of the ozone upon the membrane of the nose and throat of those persons regularly employed in the office. In the lecture-rooms, however, where there were large room volumes and many people, the room air was freshened and deodorized and no complaints were made by any persons subjected to its influence for one hour.

The author's paper, therefore, as an exponent for the use of ozone in the art of air conditioning, deserved commendation, but it weakened its position in making final and sweeping conclusions concerning those phases of air conditions upon which there was, as yet, so much uncertainty.

His conclusion was merely this: When air conditions within room interiors become the same as those of the pure outside air, the best physical health of the people might be expected.

Slag as an Aggregate in Concrete*

By W. A. Aiken

EVERY new or extended utilization of by-product makes for economy in the conservation of resources. The millions of tons of blast-furnace slag annually produced in the United States, for years considered not only practically worthless, but always a nuisance, and entailing unavoidable expense in handling and disposal, have from time to time to some extent been utilized in a variety of ways; one very important use of certain of these slags being in the manufacture of a valuable product, Portland cement. But the percentage of furnace slag made use of thus, or indeed in any other way, such as for track ballast or for building macadam roads, is at present relatively very small, and yet is actually considerable in tonnage. Any increase in the use of this product to the extent outlined in this paper, should the adaptability of slag for concrete aggregate be generally recognized, would furnish a very desirable outlet. To be sure, its adaptability for this purpose has always been recognized by large iron manufacturers, who early made use of this handy material, when concrete construction was undertaken around their plants; but it has not been adopted generally.

With the marvellous growth in recent years of concrete construction, and especially reinforced concrete, the advantage of furnace slag as an aggregate in reducing the dead weight per cubic foot of concrete, has made a strong appeal to many concrete engineers. The result is that the building codes of several of our large municipalities have permitted the use of furnace slag equally with any other material ordinarily used for aggregate in concrete.

In the course of our professional work during the past year we have made an extended investigation of certain slag-concrete. The particular value of our work, we think, lies especially in the fact that any conclusions to be drawn therefrom are based on a large number of test results, very much more than the number from which averages are ordinarily deduced. In consequence, we feel that any deductions submitted are reliable, and while tests on slag-concrete specimens have often been made previously, and the results in some cases published, so far as our examinations of these are concerned the number of tests from which average results were deducted at each period was comparatively limited, and, consequently, the conclusions therefrom are correspondingly less reliable.

Originally we made a few comparative tests using different aggregates, such as limestone, Birdsboro trap rock, and slag; the tests being carried on only to the twenty-eight-day period. This was done to arrive independently at the relative actual values of these different materials. As a result of these early tests and the showing made therein by slag, we undertook an extended series of tests involving the manufacture of five hundred 6-in. cubes; 100 of these to be crushed at each of the several periods—28 days, 3 months, 6 months, 9 months, and 1 year—so as to arirve at entirely reliable averages, and to establish the uniformity of the character of the concrete. As the work progressed results were such that the number of cubes tested at the 9-month and 1-year periods was reduced to 50 each, and it is proposed to crush the remaining 100 cubes at 6-month intervals up to 6 years—10 cubes at each period.

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*Paper presented at the last annual meeting of the American Society for Testing Materials.

The materials used in this investigation were all commercially procured in Philadelphia, and the work of making the specimens was no better than that under ordinary field conditions of concrete construction—no attempt having been made to enter into any elaboration. Thorough mixing, however, was positively assured, the work being done by hand. The moulds used were in gangs of tens and made of planed 1-in. white pine lumber, put together with screws. The cement used was a standard Lehigh Valley brand, showing the following compliance with the standard specifications of the American Society for Testing Materials:—

Fineness.—No. 100 sieve, 96.0 per cent. passing; No. 200 sieve, 81.2 per cent. passing.

Time of Set.—Initial set, 5 h. 30 m.; final set, 6 h. 10 m.

Constancy of Volume.—Passed the cold water-pat, air-pat, steam-pat, and boiling-pat tests favorably.

Tensile Strength.—(Average of five briquettes.)

Neat.

24 hours.	7 days.	28 days.
219 lbs.	601 lbs.	704 lbs.

1 cement: 3 sand.

7 days	28 days.
272 lbs.	347 lbs.

Temperature of laboratory air, 70 deg. F.

Temperature of gauging water, 68 deg. F.

The sand used was Jersey gravel, the material almost universally used in the vicinity of Philadelphia. This showed the following granulometric analysis:

Sieves	Amount Passing
¼ in.	97.4 per cent.
No. 10	90.8 "
No. 20	72.8 "
No. 30	63.8 "
No. 40	55.2 "
No. 60	35.4 "
No. 100	11.6 "

This is not ideal material, as will be recognized, but was used because it is the material of the market.

The coarse aggregates, commercially called ¾-in. material, all passed the 1¼-in. sieve and were retained on the ½-in. sieve.

The slag used showed the following chemical analysis:

Silica (SiO_2)	34.40 per cent.
Alumina and iron oxide (R_2O_3)	23.40 "
Lime (CaO)	35.88 "
Magnesia (MgO)	3.21 "
Sulphuric anhydride (SO_3)	0.39 "
Sulphur	1.27 "
Loss on ignition	1.34 "

All material was measured by volume in the proportions of 1 part cement, 2 parts sand, and 4 parts coarse aggregate: this being the requirement of the Philadelphia Building Laws. All the concrete was mixed to ordinary work consistency—rather wet than dry.

The preliminary investigation for comparative purposes gave the following average results from three 6-in. cubes at 7 days and three 6-in. cubes at 28 days.

Coarse Aggregate	Comparative strength, lb. per sq. in.	
	7 days	28 days
Limestone	390	941
Birdsboro trap rock	1,144	1,888
Slag	1,681	2,537

There was then undertaken the main investigation covering the manufacture and testing of the 500 slag cubes. These were all air-stored in a dry cellar, being sprinkeld with water once a week.

A study of the detailed differentiation of test results shows that at 28 days, 3 months, and 6 months, of the number of individual tests failing to closely agree with the several general averages, the large percentages of these show considerably greater strength than these general averages or than the average of the larger percentages of tests which agree so closely with the several general averages. The average strength noted in all tests at these periods—28 days, 3 months, and 6 months—may, therefore, be assumed as thoroughly conservative.

A similar study of results at 9 months and 1 year shows that of the results not in close agreement with each period's general average, or with the larger number of tests at each period which closely approximate these general averages, a somewhat larger percentage falls below this general average than that which runs above. But as those results which are above the general findings average relatively much more above such general findings, than the low results average below these general findings, it may again be assumed that the average strength results of all tests at the later periods of 9 months and 1 year are equally conservative.

This is more particularly evident when it is borne in mind that the sand used was not what could be considered first-class material, and undoubtedly influenced the strength of the concrete developed. Also, the comparatively small size of the slag aggregate must necessarily have influenced the strength of the concrete, while the results would probably have been higher had the test specimens been larger. It is also to be noted that, in so far as the author's observation goes, the results are markedly lower than those published by other investigators of slag concrete.

The main point is whether the compressive-strength values herein developed are sufficiently great to warrant the employment of slag as aggregate, in competition with broken stone and gravel. We think the findings are in favor of this, since our experience has been that the crushing strength of broken stone or gravel concrete, made up under ordinary field conditions, will not average over 1,500 lbs. per square inch at the age of thirty days.

Consequently, from the actual strength of the concrete developed in these tests; its weight per cubic foot (which is less than that of most materials used similarly); the recognized solubility of slag, which permits it to act as a puzzolanic material; its alkaline nature, which is especially conducive to rust-prevention in the case of reinforced concrete construction, and from the relatively high combined percentages of silica, alumina, and iron, which make for permanency of the resulting concerte: we conclude that slag of similar constitution is in every way satisfactory for use as aggregate in concrete.

To make a hole in glass, cover the glass with clay or putty for a few inches around the place where the hole is wanted. With a pencil or small stick, make a hole in the clay or putty the size of hole required. Pour this hole full of melted lead.

The Welland Canal, for which all contracts have been let, is to be finished by 1918 at a cost of $50,000,000, all of which is to be borne by the Dominion Government. At present about two thousand men are at work excavating the northern end of the canal.

Fuel Oil and Its Application

An interesting paper on the above subject was presented by Mr. J. J. Ferris, late Superintendent of the Oil Service of the C. P. R., at a meeting of the Vancouver Branch of the Canadian Society of Civil Engineers on December 3.

Mr. Ferris prefaced his remarks concerning the use of fuel oil by a brief outline of its history. Oil was known before the Christian Era. The Chinese and Japanese worked oil deposits in a primitive way for centuries and both the Incas of Peru and the Aztecs of Mexico employed petroleum in their works of art. In Galicia and Roumania are old workings that show that petroleum was extracted there ages ago. As early as 1856, settlers of California collected the more liquid petroleum from seepages and refined it in a crude way, but this was not a success financially. The first drilling for petroleum was done by Colonel Drake in the Appalachian Mountains of Pennsylvania in the year 1859. In 1871 the first well in Russia was drilled at the oil-fields of Baku.

Owing to the lack of facilities for handling crude oil, progress was very slow and unprofitable until the year 1865, when it was demonstrated in America that oil could be transported advantageously through steel pipes. Following the example of America, Russia constructed a pipe line for transporting oil to the Caspian Sea, and in 1879 the first steamer ever built for transporting oil was built by a Russian firm for carrying oil across the sea.

Very little development work was done in California until 1892, and within three years some two thousand four hundred oil companies filed incorporation papers in the state. But of these twelve hundred companies did some actual drilling.

Oil was discovered in Eastern Canada in the late seventies with Ontario leading in the output, having paying wells since 1881. Numerous oil indications have been found in Alberta, British Columbia and Athabasca—especially in Athabasca, where there are immense asphaltum beds. The latest excitement is in Alberta, at a place called Cochrane, on the Canadian Pacific Railway, the oil wells being near this town. There oil was struck at a depth of 1,620 feet. It is a high grade oil similar to that found in Pennsylvania.

Oil-bearing strata are principally of a porous character, such as sands, sandstone, limestone and gravel. Some of the oils from Ontario and Eastern United States and Texas are found in limestone, but apart from these most of the oil in the world is found in a sandy formation. The drilling, as a rule, is through hard pan, clays, limestone, sandstone and sands, all of different hardness and thickness and as a rule, but not always, the oil sand lies under a stratum of clay. The majority of the oil flowing wells contain water of a saline nature, and it is said that the search for brine led to the discovery of petroleum in the United States. In some places salt has been produced on a commercial scale, by evaporating water pumped from wells sunk in oil strata.

The depth of oil wells varies greatly. In Ontario there are oil wells at a depth of only 500 feet, although some again are over 3,000 feet deep. In California they are from 600 to 4,000 feet deep, and cost about $5.00 per foot for drilling, including casings. This is the contract price when several wells are to be drilled. The rig for drilling is a derrick from 50 to 80 ft. high, with a base from 16 to 20 ft. On the top are two pulleys, one known as the crown and the other as the sand pulley. The drilling is performed by a heavy string of tools suspended from a flexible Manila cable 2 x 2½ ins. diameter. These tools then fall back by gravity. The cable is attached to a drum, known as the bull wheel, for lowering and hoisting the tools.

Field, B. C.—15,000 bbl. storage and 600 bbl. gauging tank, with concrete pump-house.

Kamloops, B. C.—Bottom and first ring of 15,000 bbl. storage tank.

Steel casing is the casing generally used when drilling a well, the size of casing depending on the depth of the well and character of strata. As a rule the string of casing is 12½ ins. inside diameter and finishing with 6½, 5 3-16 or 4 ins. inside diameter, this, as said before, depending on the condition of strata, water, etc. The last casing must be tight to prevent the water between the surface and the oil bodies from mixing with the oils, and also in case of a heavy pressure of gas or oil, to keep it from breaking through the earth near the surface. Where the ground is fairly level and open, and the wells are within 600 or 700 ft. of each other, as many as 25 wells can be pumped from a central station by Jerker lines. A common type of pumping frame is a vertical shaft driven by a bevel gearing from a horizontal shaft, several eccentrics being attached to the vertical shaft, with a number of holes in the outer flange for fastening straps or cables (Jerker Lines) leading to the different wells.

The oil from the wells is pumped into sumps, allowing the sand and water to settle. From there it is pumped to large storage reservoirs built of earth. These reservoirs are scraped out with teams, the material being used for the embankment. The bottom and banks are water soaked and teams driven over them until they become dry. These dry quickly during the hot weather, making them practically tight from seepage. There are also earth reservoirs lined with concrete reinforced with wire mesh. The Union Oil Company have three reservoirs built entirely of concrete. These are 600 feet in diameter by 22 feet 6 inches high having a capacity of 1,000,000 barrels. The oil is drawn off through pipes in the bottom of the reservoirs to tanks, where it is heated in cold weather, then pumped through pipe lines to the refineries or storage tanks on the coast. From here it is loaded on tank steamers for transportation. These steamers have a capacity of from 25,000 to 75,000 barrels.

There are several long pipe lines throughout the state of California. At present one 8 ins. in diameter is being laid between Coalings and Martinez, a distance of about 178 miles. The longest pipe line, to the writer's knowledge, is 280 miles long and extends from the Kern River fields to the Point Richmond refinery. This is operated by the Standard Oil Company. The pumping stations on the pipe line are from 5 to 20 miles apart, these distances depending on the grade of the line it passes over.

The crude oil found in the Eastern States and Canada is mostly of a paraffine base, while that on the Pacific Coast is of an asphaltum base. Paraffine base oil is too valuable to use as a fuel oil, as there are some three hundred articles of commerce manufactured from it.

C. P. R. Installation Effects Great Saving

There are a great many wells producing oil of a gravity that does not need distilling for use of fuel oil, while there are others of too low a gravity which are mixed with a higher gravity oil, producing a gravity suitable for the purchaser—for instance, the C. P. R. use a 14 degree gravity Baume for their steamships, and a 17 degree for their locomotives. These oils are delivered in Vancouver by the Union Oil Company's tank steamers to three 55,000-barrel storage tanks situated near Coal Harbor. Each barrel contains 42 gals. U. S. measure. The oil is distributed from these tanks to the steamboats and along the main line of the railroad for the locomotives and stationary boilers.

At the three storage tanks there is a pumping plant. This plant has two 150 h.p. water tube boilers and two compound duplex pumps, having a capacity of 500 barrels each an hour. The piping is so arranged that either pump can be used from any one of the tanks. The oil is pumped from these large tanks to gauging tanks of 1,000 barrels capacity; and from here to the steamers by an electrically driven pump through a pipe line placed under the dock, along the water front. The oil is also pumped from the large storage tanks to the tank cars. These tank cars have a capacity of 240 barrels each, and distribute the oil to the different pumping stations along the main line of railroad, from Vancouver to Field, a distance of 510 miles.

Following are the stations, in order, according to the capacity of their tanks:—There is a 600-barrel gauging tank, erected on a steel tower 20 ft. high, at Vancouver, Mission Junction, Sicamous and Golden; a 1,000-barrel gauging tank, on 20 ft. tower, at Notch Hill; a 15,000-barrel storage and a 600-barrel gauging tank at North Bend, Kamloops, Rogers Pass and Field; a 22,000-barrel storage tank and 600-barrel gauging tank at Coquitlam and Revelstoke. At each of these stations is a pumping plant and a concrete unloading sump, into which the oil from the tank cars is emptied and from there pumped to the storage and gauging tanks.

The plan for distributing oil to the locomotives is to pump from the storage tanks or sumps to the gauging tanks, but it is so arranged in case of accidents to tanks that the oil can be pumped direct from sumps to locomotives. The sumps mentioned are of concrete 16 x 16 x 6 ft. deep, built in the ground, the top of same built level with the top of the rail. The sumps and tanks are equipped with a system of heating coils to keep the oil from becoming thick and heavy during the cold weather, and especially in the gauging tanks, from which it is delivered through the stand pipes to the locomotives by gravity.

In conclusion, we have in favor of liquid fuel the following points: ease of transportation and hauling; reduction of storage bulk; increased cleanliness both inside and outside of boiler-room; reduced labor in firing; reduced cost per unit of heating value; increased percentage of efficiency; increased steaming capacity of generators, and great ease of regulation.

Preventing Odors at Refuse Disposal Plants

HIGH furnace temperatures, forced draft and careful regulation of the fires to secure perfect combustion are necessary to prevent odors at refuse disposal plants. These are among the points made by Dr. Rudolph Hering, consulting engineer, of New York, in a paper presented at the recent meeting in Jacksonville of the American Public Health Association.

To prevent odors about the plant, Dr. Hering said, no refuse should be stored longer than a day before it is incinerated, although an offence from mixed refuse does not arise as soon as from garbage alone as generally delivered at a reduction plant. It is further generally wise to arrange hoods and ventilating pipes in the furnace building to receive and carry the air, which may have become somewhat foul from contact with the refuse. The foul air should be conducted to a point below the furnace grates and used with forced draft, so that the intense heat of the fire will thoroughly purify it.

As at reduction works it is advisable to keep incinerating works scrupulously clean. No refuse should be left scattered about. Dust from the final clinker and ashes should be properly controlled, and the floors of the buildings should be swept or washed daily. The walls of the buildings, the tools, clothing, etc., should be given, as often as found desirable, a blast from nozzles supplied with compressed air.

A Pennsylvania wire glass company has evolved a new type of glass that solves a problem often of great importance in manufacturing plants—that of eliminating the drip from the underside of skylights. In many of the arts, in silk and cotton mills, paper factories, chocolate works, etc., the falling of a single drop causes great damage. The new glass is called "Aqueduct" and the under-surface has eight webs or channels to the inch, the webs being of such form as to give the greatest degree of capillary attraction. The result, says Safety Engineering, is that, even when pitched as low as ten degrees above the horizontal, all condensation is held and carried down to the gutter at the foot of each sheet. The strength added by the webs is so great that the makers guarantee the glass for one year against breakage from any cause whatever. This company is the first in the history of glass manufacture to make such a guarantee.

Design, Construction and Detailed Costs of the Richelieu River Bridge

THE renewal under traffic of the Richelieu River Bridge at Lacolle Junction, Quebec, by the Grand Trunk Railway possesses a number of interesting features. This bridge, which spans the Richelieu River, the northern outlet of Lake Champlain, originally consisted of a 180-ft. swing span (providing two clear channels of 73 ft. each) and pile trestle approaches, the east approach having a length of 350 ft. and the west one a length of 500 ft. The centre pier and the rest piers of the old swing span consisted of timber cribs filled with rubble stone surrounding the supporting piles, the latter being capped with timber grillage which in turn supported concrete tops. The superstructure for the new bridge consists of thirteen piers, including the pivot pier, and two abutments. In addition to the construction of these piers and abutments the renewal of the bridge required the reconstruction of the old protection cribwork, the construction of wing protection cribs and booms, and the removal of the old protection works, rest piers and trestle. The work was completed in 1913 and is described very fully in a recent issue of our Chicago contemporary, Engineering and Contracting, whose article we present herewith in abstract.

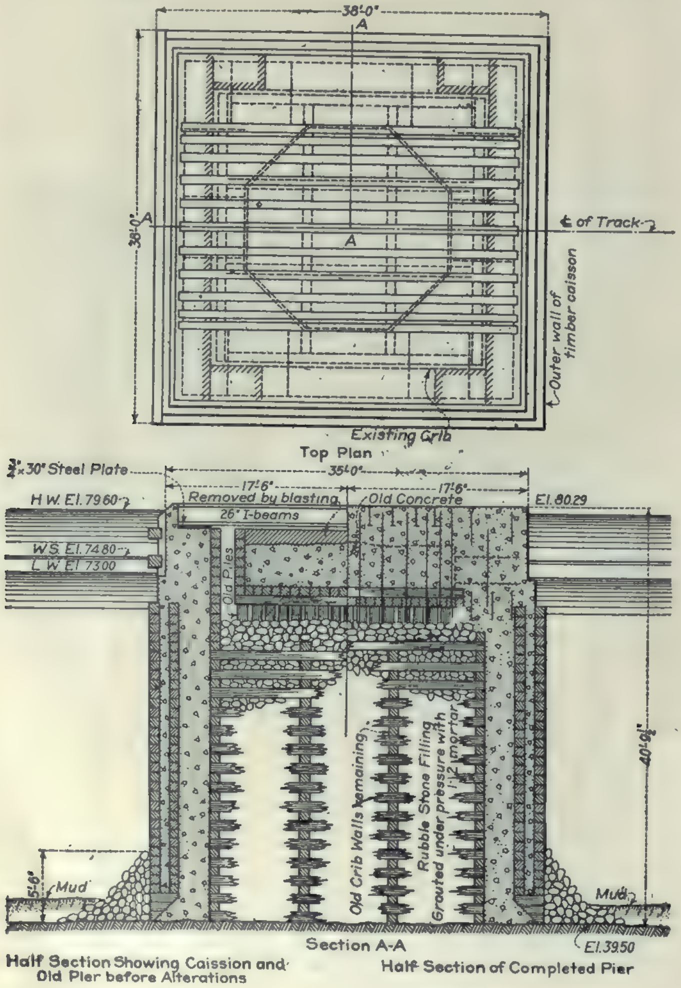


Fig. 1—Plan, half section of old pivot pier and half section of completed pivot pier of Richelieu River bridge.

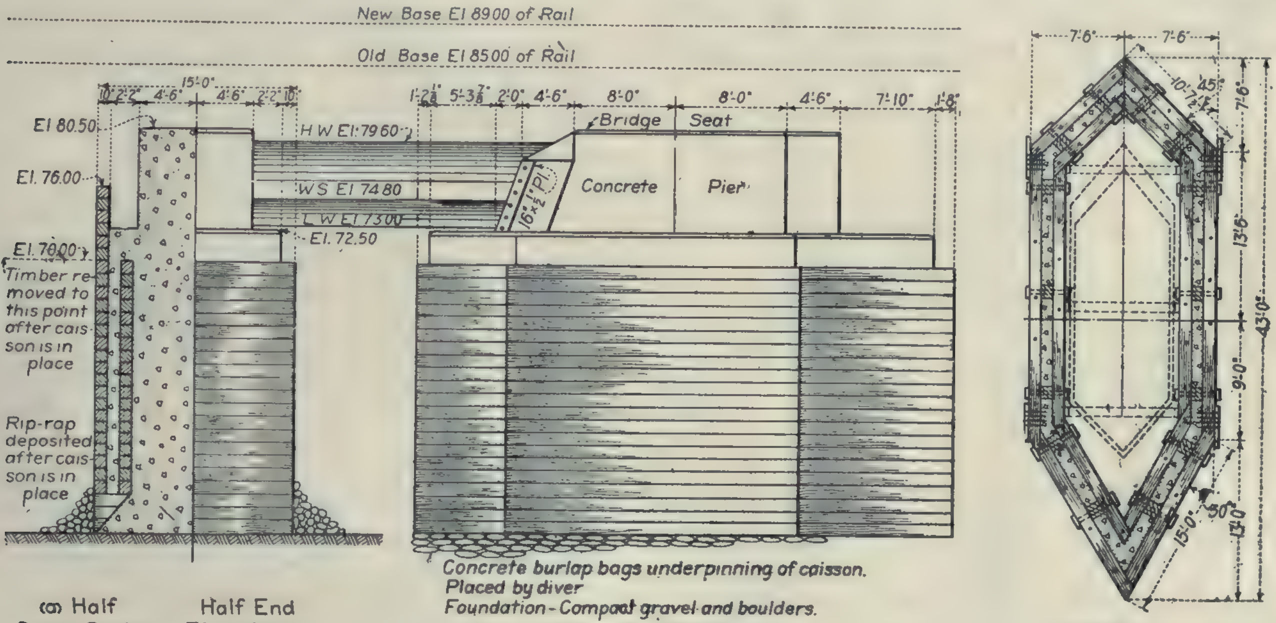
Substructure.—The new pivot pier was built around the old pier and a new concrete top constructed, the superstructure being supported during construction on steel grillage beams. These beams had for their support the new concrete shell which surrounded the old pivot pier. The open caissons used in constructing the pivot pier and seven of the twelve remaining piers, including the two rest piers, had double walls consisting of 10 x 10-in. timbers, the two parts of each wall being separated by 12-in. vertical timbers resting on a heavy shoe. These caissons were sunk by filling the 12-in. space in each wall with concrete and by adding other loads. The caissons used for the other five piers were also of the open type, but they had single walls consisting of 10 x 10-in. timbers. These caissons were sunk by loading them with rails. The two abutments required timber cofferdams.

The old pivot pier consisted of a timber crib 26 ft. square and 33 ft. high, filled with rubble stone, which surrounded the 108 piles. These piles were capped with a timber grillage, which was 3 ft. below low water and which supported a concrete top 8 ft. high and 20 ft. in diameter. A timber wall surrounded the concrete top, and the space between it and the crib was also filled with rubble stone. As this pier was considered too unstable for the loads which would be thrown upon it by the new bridge, it was reinforced in the following manner:

A double-wall caisson, 38 ft. square, outside dimensions, built up of 10 x 10-in. horizontal timbers and 12 x 12-in. vertical timbers between the walls at intervals, was sunk around the old pier, leaving a 3-ft. space between it and the old crib. After this space was filled up to approximately 6 ft. below low water with plain concrete, reinforced concrete walls were carried up to the required level to receive the eleven 26-in., 166-lb. I-beams, on which the swing span was erected and operated during the completion of the piers. Fig. 1 gives a plan, a half section showing the caisson and the old pivot pier before alteration, and a half section of the completed pivot pier.

It was originally intended to remove the rubble stone filling from the old crib one pocket at a time, but this was found to be impracticable owing to the existence of fissures in the slate-rock foundation, which made unwatering impossible. The stone was, however, taken out to a level 2 ft. below the old timber grillage. The old piles, the timber grillage and the concrete top were left in place, except the upper 18 inches of the latter, which were removed by blasting. Instead of unwatering the pier, water was pumped into it until a 3-ft. head was produced, this head being utilized in forcing a 1:2 grout into the voids of the rubble stone. After the voids were filled the water was pumped out, and the concrete work was completed in the dry, grillage beams being embedded in the coping to distribute the loads from the swing span.

Seven of the intermediate piers have caisson foundations, which are of similar construction to that used for the pivot pier and which differ only in shape. These piers are pointed, both on the upstream and downstream ends. Fig. 2 (a) shows a half cross section and a half end elevation of a typical intermediate pier and caisson in which the double-wall type of caisson was used; Fig. 2 (b) shows a side elevation of the pier and caisson; and Fig. 2 (c) shows a plan of the caisson. Above elevation 70 (the top of the permanent caisson) the construction for all of these piers is alike. The respective heights of the seven piers, from foundation to base of rail, are: Pier No. 4, 29 ft.; pier No. 5, 34 ft. 6 in.; pier No. 6, 37 ft.; pier No. 7, 39 ft.; pier No. 9, 41 ft. 6 in.; pier No. 10, 39 ft. 6 in.; and pier No. 11, 41 ft. The tops of these concrete piers have a length of 16 ft. and a width of 9 ft. From the top of each pier, at elevation 80.5, down to elevation 72.5 (which is 6 in. below low water level) the downstream face is vertical, while the upstream face is bevelled and is reinforced with a 15 x ½-in. plate. Below elevation 72.5 each pier has a width of 13 ft., and a length of 40 ft. 1⅞ in. Originally it was intended to make the length of the rest piers, Nos. 7 and 9, 36 ft. long and 10 ft. wide, but it was finally decided to make the dimensions of all piers requiring double-wall caissons the same. The caissons for these piers have an outside width of 15 ft. and an outside length of 43 ft. The upstream nose forms an angle of 90 deg., while the downstream face makes an angle of 60 deg. The outside 10-in. timber walls are carried up to elevation 76.0, and the inside walls to elevation 70.0. After these piers were completed the outside walls were removed down to the 70.0.



(a) Half Cross Section Half End Elevation (b) Longitudinal Elevation (c) Plan

Fig. 2—Details of typical intermediate pier and double-wall caisson of Richelieu River bridge.

The five single-wall caissons (Nos. 1, 2, 3, 12 and 13) are similar in shape to that shown in Fig. 2, the piers for which these caissons are being used being located in comparatively shallow water. Fig. 3 shows details of these piers and caissons. The elevation of the tops of these piers is 80.5, while the elevations of their bottoms are: pier No. 1, 65.17; pier No. 2, 64.34; pier No. 3, 62.66; pier No. 12, 61.83; pier No. 13, 66.0. After these piers were built the caisson walls were removed down to elevation 68.5.

The caisson shoes were constructed on land and were launched from a skidway. The caissons were built up in place.

Fig. 4 (a) shows a plan of the east abutment; Fig. 4 (b) shows a longitudinal section along the centre line of the abutment; and Fig. 4 (c) shows a cross section of a wing wall.

In general the piers rest on slate rock, hardpan or compact gravel, except piers Nos. 12 and 13 and the east abutment, which required pile foundations. The compact material under pier No. 11 was overlaid with about 7 ft. of loose material, which was removed by an orange-peel bucket. Before the piles were driven for piers Nos. 12 and 13 about 5 ft. of the top soil was removed. Before placing concrete, a diver levelled off the foundation for each pier and also for the protection works. In addition to this work the diver, who was employed continuously on the job, assisted in landing the caissons, in blasting boulders from the cutting edge, and in blasting away the old crib protection works.

After the caissons reached bottom they were underpinned with burlap bags of concrete and were then filled with concrete, which was deposited by bottom-dump buckets. The water was then pumped from the caisson and the concreting continued in the dry.

The rest piers and the pivot piers were started after navigation had closed, and the work was sufficiently advanced to permit the swing span to be erected in time for the opening of navigation. Some severe weather was encountered, and the temperature was as low as 28 deg. below zero when the upper part of the pivot pier was concreted.

All of the protection piles and cribs of the old bridge required replacing, the new work consisting of six cribs built of 10 x 10-in. timbers and loaded with rubble stone. The three cribs near each rest pier are connected and are joined to the rest pier by floating booms. These booms consist of 12 x 12-in. vertical timbers bolted to the cribs and rest piers. The old centre protection work below low water was left in place, and, after being strengthened by the addition of five new cribs, a new top, consisting of a double row of walings, was constructed.

Superstructure.—The bridge, which is a single-track structure, was designed for Cooper's E-50 loading. The unit stresses used are those given in the 1910 specifications of the Grand Trunk Railway, the impact allowances being those given in the Dominion Government's 1908 specifications. The twelve deck plate girder spans possess no unusual features.

The swing span has a length, centre to centre of end floor-beams, of 244 ft. 7½ in., and a centre height, centre to centre of chords, of 36 ft. It is of the centre-bearing type, the ends being raised and lowered by wedges operated by hand power. The trusses of the swing span are spaced 18 ft. on centres, each truss consisting of eight 28-ft. 6-in. panels and a centre panel having a length of 16 ft. 7½ in. The distance from top of pivot pier to base of rail is 11 ft.

Instead of using concentrated wheel loads in computing the stresses in the swing span equivalent uniform loads were used. The equivalent uniform load used for one arm was 6,400 lbs. per linear foot, and that for the entire span, 5,700 lbs. per linear foot. The dead load assumed for this span was: floor, 735 lbs. and steel, 2,365 lbs., a total of 3,100 lbs. per linear foot.

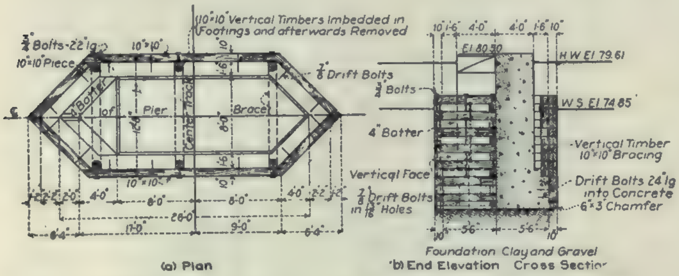


Fig. 3—Details of pier and single wall caisson used in shallow water—Richelieu Bridge.

The following cases were considered in determining the stresses in the trusses:

Case I.—Dead load, bridge as cantilever.

Case II.—Dead load, bridge on three supports.

Case III. (a).—Live load, bridge on three supports, loads at b, c, and d.

Case III. (b).—Live load, bridge on three supports, loads at c and d.

Case 111. (c).—Live load, bridge on three supports, load at d.

Case III. (d).—Live load, bridge on three supports, loads at b and c.

Case III. (e).—Live load, bridge on three supports, load at b.

Case IV.—Live load, bridge on three supports, fully loaded.

Case V.—Live load, bridge as simple span, one arm on two supports.

Fig. 5 shows an outline of the trusses of the swing span, and gives the stresses in the truss numbers, and their composition.

The circular girder, which has a diameter of 18 ft., consists of four 6 x 4 x ⅝ in. angles and a 24 x ¾ in. web. The wheels are 12 in. in diameter and 8 in. wide. The centre bearing steel casting is the Grand Trunk Railway's patent No. 11,283.

The 60-ft. plate girder spans were erected, completely rivetted, by means of a derrick car. The twelve girder spans were erected in 5½ days, the traffic having been diverted during their erection.

The Cyclone, the first of two large dredges to be built for harbor improvement work at Toronto, was launched recently from the Polson Iron Works. Although this dredge is surpassed in size by some of the dredges used in constructing the Panama Canal, it is said to be the most powerful dredge in the world. It has been built for the Canadian Stewart Company, which has the contract for improving the harbor of Toronto, a work requiring the removel of some 35,000,000 cu. yds. of sand from the bottom of the harbor to the Ashbridge Bay district, which is being reclaimed for an industrial area. It is understood that the Cyclone has the capacity for handling 15,000 cubic yards a day. The length of this dredge is 170 ft. and the width 42 ft. Steam is furnished by 4 Babcock boilers of a semi-marine type. At the end of the ladder, which is 100 ft. long, is a boring machine that weighs 50 tons. By means of a long stick of Pacific Coast fir swung at the opposite end of the dredge, the suction pipe can operate in a channel 500 ft. in width. The boring mechanism is operated at the end of the suction line by a 500 h.p. engine. The pump in the middle of the dredge, which is worked by an engine of 1,750 h.p., can handle very large boulders. The dredge is equipped with a pipe line more than a mile in length.

Swimming pools with sand filters and movable bulkheads have been proposed by Prof. W. S. Franklin, of the Lehigh University. The object is to let the bulkhead push the used water in the pool into the filter, while back of it the pool is refilled with pure water. The bulkhead is built so that it automatically scrubs the bottom and side walls of the pool.

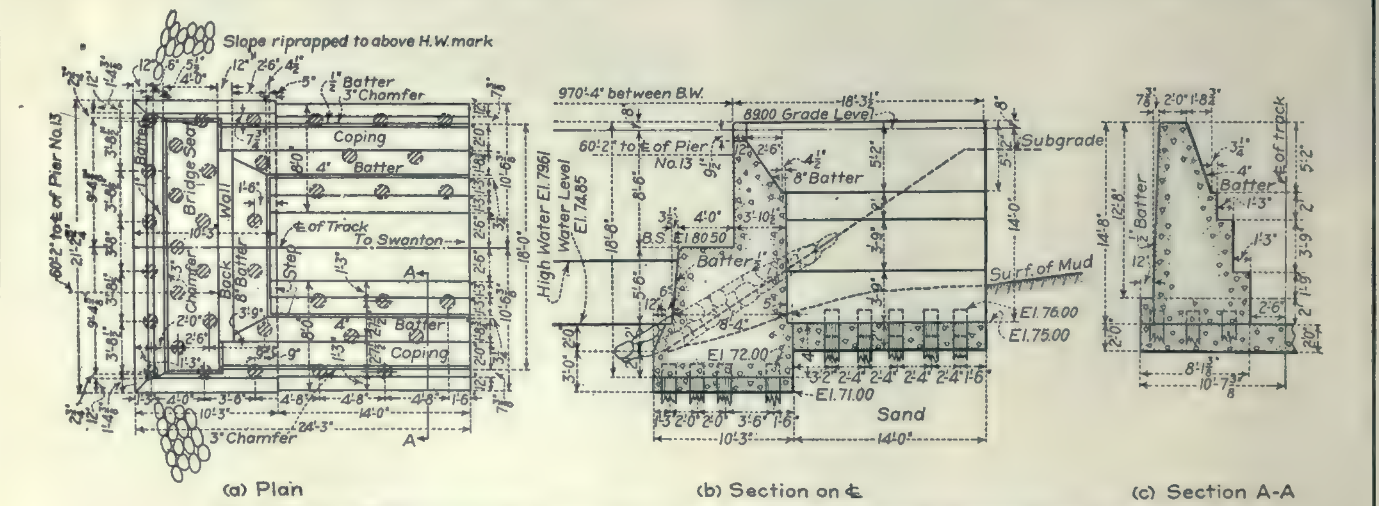


Fig. 4—Plan, longitudinal section and cross section of wing wall of east abutment of Richelieu River Bridge.

Concrete Road Construction*

By H. J. Kuelling†

WHILE there are several isolated cases of concrete roads that are fairly old, the pavement is a type that is quite recent and has had a phenomenal growth within the last five years. Naturally with such a growth, there have come about changes in the opinions of engineers relative to the best practices. Without a doubt there will be many great changes before the standards are unified and many of the things we are now doing will be looked back upon as rather poor engineering.

Roadbed.—As in all forms of road construction, the roadbed for a concrete road is almost as important as the wearing surface itself. However, because of the rigid nature of the pavement, I believe that the roadbed can be of poorer quality for this form of road construction than that in any other form that I know of. This does not mean that I recommend the neglecting of proper preparation of the roadbed, but as engineers know, in preparing a road in very dry weather, springy and spongy places are sometimes overlooked and in the cases of non-rigid roads these places will show up at some future date, whereas with a concrete road I believe that the slab often bridges these places and no serious results come about excepting a possible cracking of the road. I think a little too much attention has, perhaps, been paid to thorough rolling of the sub-grade rather than to the thorough destruction of the old road surface in order to have a sub-grade of uniform density under the new road. In my own work we did practically no rolling other than that accomplished by traction engines drawing the graders, or, in a few cases, by tractors hauling material.

Width and Thickness.—This is a subject that has given rise to a great deal of discussion. My personal practice is to use a flat sub-grade, with fairly deep ditches alongside the road to care for drainage. My experience has been that where there is a motor traffic of a thousand or more vehicles every day, an eighteen-foot road is none too wide. With only a few hundred a day, a sixteen or possibly a fifteen-foot road might be ample. In connecton with the width we must consider the ever-increasing amount of reckless driving occurring upon our highways.

The thickness that I am using on our roads, which are sixteen and eighteen feet in width, is six inches at the edges and eight inches in the middle. I believe the thickness will ultimately partly determine by degrees the density and homogeneity that we are able to obtain in our concrete. I believe this because the homogeneous concrete will have an even wear similar to good sandstone and that an increased thickness will merely mean an increased life of the road.

Cement.—Getting the proper amount of cement into the road is, I believe, one of the difficult things to accomplish at the present time, especially where the contractor is inclined to be negligent. This is overcome largely in my county by furnishing all cement delivered to the contractor on the job. In this way he has no tendency to slight the proper amount. On the other hand, we hold him responsible within certain degrees for an over-run of cement and also make him responsible for the care of all empty sacks.

I believe that all cement for road purposes should be given thorough testing by reliable engineers. My opinion in this matter has been proved by the fact that we were compelled to reject a considerable number of cars of cement during the past season.

Coarse Aggregate.—In a few words, the better the quality of the aggregate, the better the quality and the longer the life of the road. In all forms of road construction it is a question of Cost versus Economy. The high-priced aggregate is sometimes more economical than the low-priced local material. We prefer a stone graded from one-quarter inch to about one and one-half inches, and of course demand that it be clean and free from any slate, shale or disintegrated stone. In our state, we limit the coarse aggregate to material having a French coefficient of wear of ten or over.

Fine Aggregate.—Our specifications for fine aggregate read as follows:—

> "Fine aggregate shall consist of clean, sharp grains of silica or hard silica rocks, and shall not contain over three per cent. of clay or loam. The fine aggregate shall have a reasonably uniform graduation from a size which will pass through a one-quarter inch screen down. Sand containing an appreciable per cent. of flat flakes shall not be used. Fine aggregates other than the above may be used only upon the approval of the engineer.

Pit Run Gravel.—In no case would I permit the use of pit run material in the concrete road.

Proportions.—I believe that too often the propor-

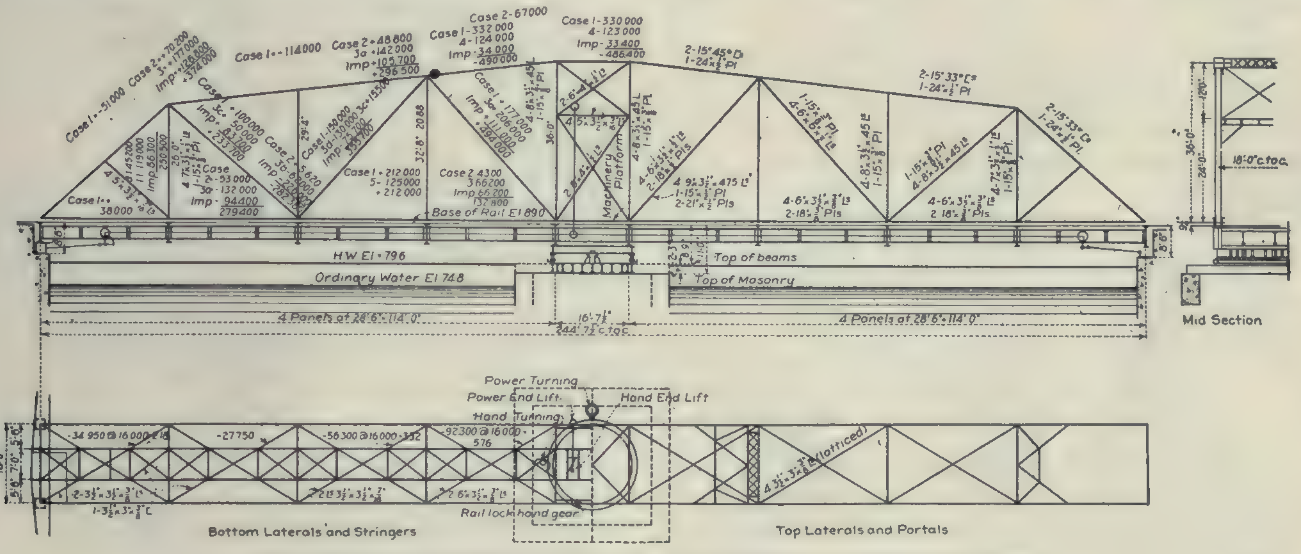


Fig. 5—Stresses and composition of truss members of new swing span of Richelieu River bridge.

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* Paper presented at the Chicago Convention of the American Road Builders' Association.

† County Highway Commissioner of Milwaukee County, Wisconsin.

tions are specified more or less blindly. It should depend absolutely upon the quality of the material obtainable. This necessitates a careful study of the voids and the make-up of the gravel or stone that might be used. The uniformity of mixing is as important almost as the amount of cement demanded. The proportions should be those that will give the greatest density and most homogeneous concrete as can be obtained with the sand and stone obtainable. If the addition of hydrated lime or some other inactive material will tend to assist in obtaining these results without lowering the abrasive value of the concrete, it should be included in the proportions. There is a wide field open for careful experiments along this line. Personally I hope to make some abrasive tests in the near future on different mixes containing hydrated lime. At the present time I am using a mix of 1:2:3½, but I would not say for a moment that this is the proper mix for all parts of the country.

Reinforcement.—It is in exceptional cases only that reinforcement is necessary in a country road, these cases being only when springy spots are encountered, or possibly where sufficient drainage is impossible due to the swampy nature of the territory.

Mixing.—The proper amount of mixing is another matter that is open for discussion. The point most commonly overlooked is the nature of the machinery. Five turns with some mixers are as good as ten with others. The amount of mixing should depend upon the shape of the individual pieces in the aggregate and also to a certain extent upon the gradation. In determining the number of turns a mixer should be given, careful watch should be paid to the speed of the drum.

Placing.—For road work proper, I prefer a spout to a boom. The main reason for this is that the material is deposited in smaller quantities—with, therefore, less tendency toward separation of the aggregate and mortar. Very commonly the boom bucket leaks and unless careful watch is maintained there is a pile of mortar left at each moving of the machine. Further the boom is additional weight to be carried around and is often the cause of delaying the work.

Finishing.—If the concrete is maintained at proper consistency, which is such that it will flow fairly easily in place and not run like water, very little finishing is required. One man can easily keep up with a good-sized crew, and about all that he should do is to smooth out the markings of the strike-off board and remove any foreign matter, such as sticks, coal or clay, which will always float to the surface. The finisher should use a wooden float at least eighteen inches in length and keep a sufficient distance back of the mixer, so that the concrete is about ready for its initial set.

Curing.—The first step in curing is to sprinkle the sub-grade in dry weather. We find this is best accomplished by the fireman connecting a small hose to the injector. The next step in curing is to protect your road with canvas in case the temperature is over ninety degrees or in case the weather is exceedingly dry and windy. When sufficiently hard the concrete should be sprinkled and covered with about two inches of earth from the side of the road and then kept wet (not in a moist condition) for about ten days.

Joints.—The question of joints is the most unsettled one in connection with concrete roads. We have increased our joint spacings from twenty-five to thirty-five feet and from thirty-five to fifty feet and at the present time I see no reason for shortening the spacing. I doubt very seriously the need for steel protecting-plates, for no matter how carefully they are placed there is a tendency to chip, thus demanding an almost immediate tarring of the joints. I believe that the joints of the future will be merely felt or paper with a slight rounding of the joint, with an edging tool, which will be filled in by the pounding down of the felt which has been permitted to stick up above the surface. I believe that the ability to get concrete that is homogeneous and impervious to water, will have a marked effect upon the spacing of joints as water content is more the cause of the movement in concrete than the changes in temperature.

Shoulders.—After trying both gravel and earth shoulders we have practically come to the conclusion that for double track roads, earth shoulders are preferable. We have found that it is not necessary to bevel off the edges of the concrete in order to make the shoulders stay in place, and now we merely round the edges to about a one-inch radius.

Inspection.—This article would not be complete without a word regarding inspection. If there is a type of road that demands thorough inspection it is a concrete road, as mistakes cannot be remedied the day following. The inspector should be a man of judgment who appreciates to the utmost the importance of detailed work. He should be a man of considerable "back bone" and one who has no political connection with the work.

Conclusion.—While concrete, in its present form, has some disadvantages, I believe that it now meets the modern traffic conditions as economically as any form of pavement known. Also, I believe that the next few years will bring about a quality of concrete and form of construction that will make a country road having a very lengthy life from a road standpoint, especially if the traffic conditions continue to change in the present direction.

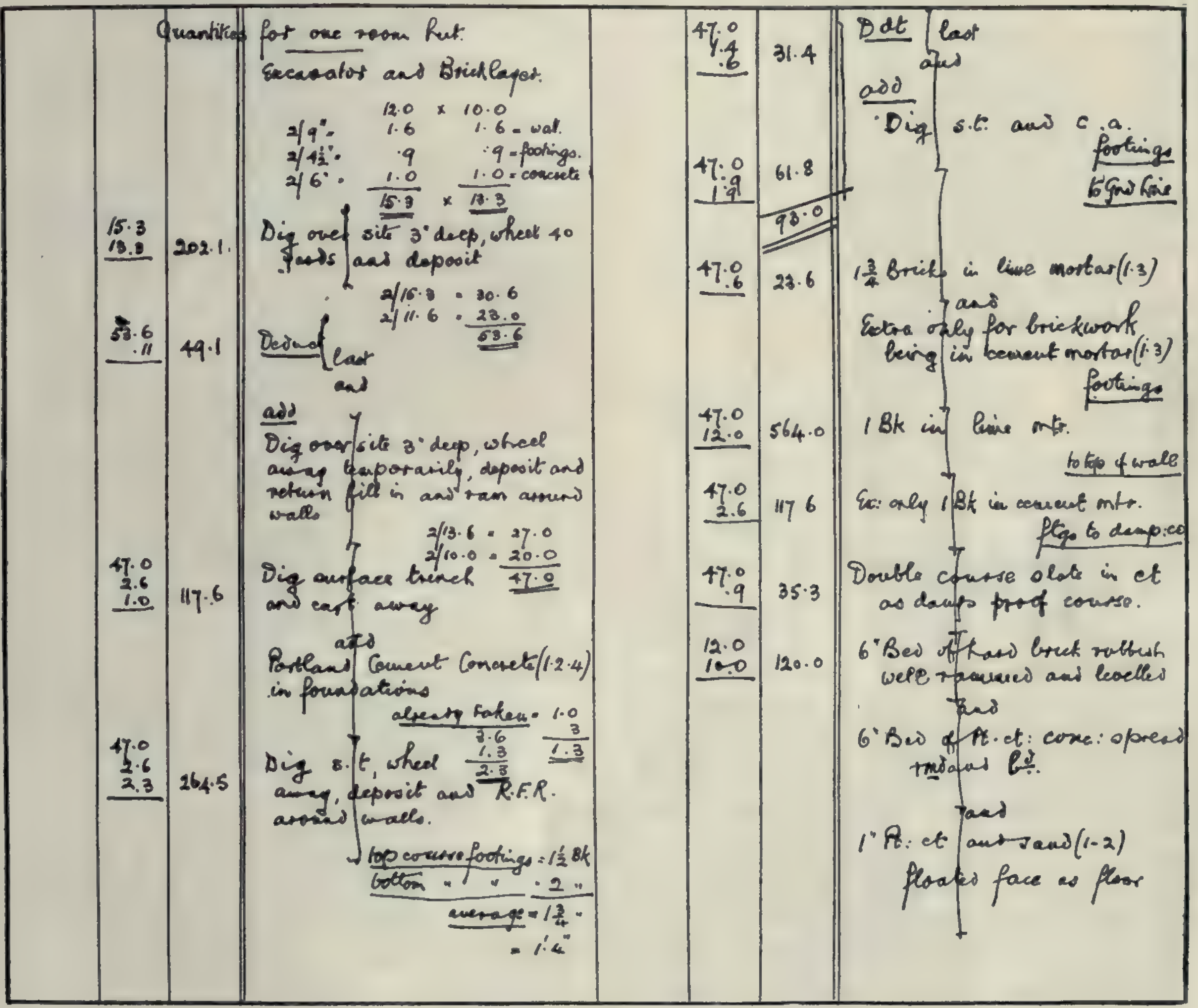
Fish ponds of sewage are provided for Bergedorf, Germany, a suburb of Hamburg, inasmuch as the town is removed from any large stream and the effluent from the Imhoff tanks and sprinkling filters is not considered complete enough to turn into the small watercourses. Dr. Edward Bartow, in a recent paper presented before the Illinois Section of the American Waterworks Association, stated that satisfactory results were obtained without dilution. Purification is effected by water plants that make the ponds suitable for fish culture. Carp less than 6 ins. long grow to a length of 18 ins. in a single summer. The flesh is good if the fish are transferred to pure water for a few weeks before they are eaten.

Working drawings on limp linen are used for all field work on the new Welland Ship Canal now being built between Lakes Erie and Ontario. Those drawings which are apt to be needed in the field are printed, brown or black on white, after the so-called Vandyke process, on ordinary white linen, and are then colored if desirable, to indicate any peculiar conditions. These linen sheets can then be crumpled into any convenient shape and carried, without much regard to their folding, in pocket or bag. They have proved very useful no account of their long wear, their freedom from creasing, and the ease with which they can be held and studied in wind or rain. When dirty they can be washed and ironed the same as a linen handkerchief. As a rule they are printed in the regular 24 x 36-in. size. The method was introduced by Mr. J. L. Weller, engineer-in-charge of the canal.

Examples of Estimating Methods Practised by English Contractors*

By G. Metson†

THE method of taking off quantities on the London System is here shown by means of a simple example. As there is some small difference in nomenclature between English and American technical terms, the words in the "taking off" have been written at first in full, but the professional quantity surveyor adopts accepted abbreviations, so that the work of taking off is very rapid. Where a word appears a second time in the quantities given, the abbreviated form has been used.



			Quantities for one room hut.
			Excavator and Bricklayer.
			12.0 x 10.0 2/9" = 1.6 1.6 = wal. 2/4½" = .9 .9 = footings. 2/6" = 1.0 1.0 = concrete 15.3 x 13.3
	15.3 13.3	202.1.	Dig over site 3" deep, wheel 40 yards and deposit
			2/15.3 = 30.6 2/11.6 = 23.0 53.6
	53.6 .11	49.1	Deduct last and add Dig over site 3" deep, wheel away temporarily, deposit and return fill in and ram around walls
			2/13.6 = 27.0 2/10.0 = 20.0 47.0
	47.0 2.6 1.0	117.6	Dig surface trench and cart away and Portland Cement Concrete (1.2.4) in foundations
			already taken = 1.0 3 1.3 3.6 1.3 2.3
	47.0 2.6 2.3	264.5	Dig s.t., wheel away, deposit and R.F.R. around walls.
			top course footings = 1½ Bk bottom " " = 2 " average = 1¾ " = 1'4"
	47.0 1.4 .6	31.4	Ddt last and add Dig s.t. and c.a.
			footings to Grd line
	47.0 .9 1.9	61.8 93.0	
	47.0 .6	23.6	1¾ Brick in lime mortar (1.3) and Extra only for brickwork being in cement mortar (1.3)
			footings
	47.0 12.0	564.0	1 Bk in lime mtr.
			to top of wall
	47.0 2.6	117 6	Ex: only 1 Bk in cement mtr.
			ftgs to damp:co
	47.0 .9	35.3	Double course slate in ct as damp proof course.
	12.0 10.0	120.0	6" Bed of hard brick rubbish well rammed and levelled and 6" Bed of Pt. ct: conc: spread tmd and ld. and 1" Pt: ct and sand (1-2) floated face as floor

Sheet giving the various dimensions.

In the second column are entered the 'id'mensions." In the fourth the "description." The third column is used for "squarings," whilst the first is used for "timesing"—in which a stroke means "times" or multiply and a dot means "add on." The figuring and words underlined on the right hand side of the description column is known as "waste," i.e., it is information showing how the dimensions are arrived at and where they are for. Waste items are of great use at the time of adjusting variations at the end or during contracts.

Where there are three rows of figures to one dimension it shows an item of work that is billed in cubic yards. Two rows show one billed in square yards or squares (100 feet superficial). One row of figures shows an item billed per foot run. How to know in what manner to book a dimension is best learned by studying the easiest way to price the particular description of work, e.g., excavation is billed in cubic yards as it is easily known how long it takes to excavate a cubic yard and also how many carts are required to cart away the total yards billed; again, timber for construction is bought by the load of 50 cubic feet in London, hence joists, rafters, plates, etc., are billed in cubic feet; again, flooring is billed in squares, as the contractor purchases his flooring in that denomination. In American practice these denominations may differ, when the method of booking a dimension—cubic, superficial or lineal—can be altered to suit the prevailing method of pricing or purchasing materials—leaving them in the denomination in which they are most easily priced.

After all the "taking off," i.e., booking the dimensions, is completed, the items are squared (third column), when they are abstracted, the dimension item being scored through as each item is entered in the abstract.

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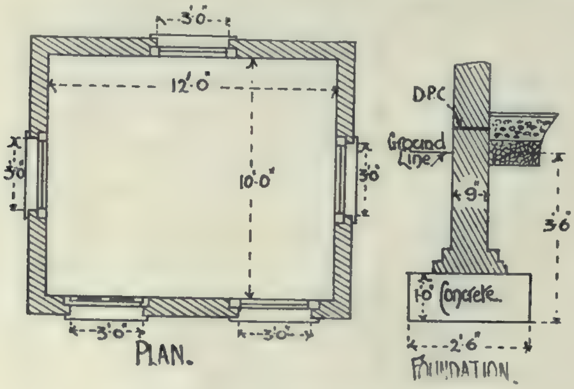
*Extract of article published in a recent issue of Building Age.

†Licentiate of the Royal Institute of British Architects. Lecturer on Quantity Surveying at the Borough Polytechnic School, London.

When the abstract is complete, the bill is merely a fair copy of the totalled or "reduced" abstract, and again the items on the abstarct are scored through as each one is entered in the bill.

The taking off, abstract and bill are given in manuscript form in order to show style and method of preparation.

In the example of taking off the waste clearly shows how the 15 ft. 3 in. x 13 ft. 3 in. digging over the site is made up. The second item is for the excess measured in the first one, for the portion that has to be returned to the outside of the walls. The third dimension is for the digging to that portion of the trench occupied by the concrete, so that the one dimension is used for the description of both "digging" and "concrete," the two being separated by the word and, the use of which avoids the writing of the dimension down again for the concrete. The fourth dimension is for the surface trench from the top of concrete to ground line. Obviously the portion of earth in the trench that will be occupied by the footings and wall cannot be returned, so the adjustment is made on the sixth dimension for the footings portion, and the seventh dimension adjusts it for the wall portion.



Plan and section of building used as example.

In order to save a lot of dimensions and their consequent squaring and abstracting, footings are averaged for brickwork. The majority of the brickwork is in lime mortar, so that all is taken in lime mortar, and the small portion (up to damp course) that is to be in cement mortar is measured as "extra only for being in cement mortar." The other dimensions call for no comments.

In the abstract each trade commences with cubic items, followed in turn by superficial, lineal and number ones. This order is always kept to. The item when ready to go to the bill has two lines placed under under it—and before the bill is written the abstract is checked again and ticked by the checker.

As all items in the squaring columns are in feet and inches, when they got totalled up on the abstract they are "reduced," i.e., divided by 27 for cubic items, 9 for superficial ones, and for brickwork by 272 to bring it to rods, etc.

Anything under half a foot is ignored. Half or over is counted another foot, so that the item for foundation concrete becomes 4 yd. 12 ft. and not 4 yd. 11 ft., whilst the first item on the abstract remains at 6 yds. 9 ft. and not 6 yds. 10 ft.

Excavation over 12 ins. deep is billed in yards cube, and 12 ins. deep or under (being the top soil and generally useful for garden purposes) is kept separate in yards superficial.

Brickwork in London is billed in rods of reduced thickness, i.e., 1½ bricks thick—a rod equals 272 ft. super. or 16½ ft. x 16½ ft.

System is essential to ensure that there is no duplication, or omission of any items. It must be admitted that the example shows a sure method of arriving at the quantities of work shown in the illustration. The walls are taken solid, without deductions for doors ors windows. These deductions will be made under other sub-heads, viz., "external openings" and "doors and windows."

All other sub-headings of work as "roofs," "windows," "doors," etc., are just as simply taken on in the London system as the present example of the subheading "excavation and brickwork," and each subhead is clearly defined, so that one does not overlap the other.

Specifications

Dig over a site to bottom of hard brick rubbish, and deposit earth 40 yards away from the hut.

The concrete to be composed of one part cement, two of clean river grit and four of clean ballast.

The brickwork to be in lime mortar (1-3) except up to damp course level, which is to be in cement mortar (1-3).

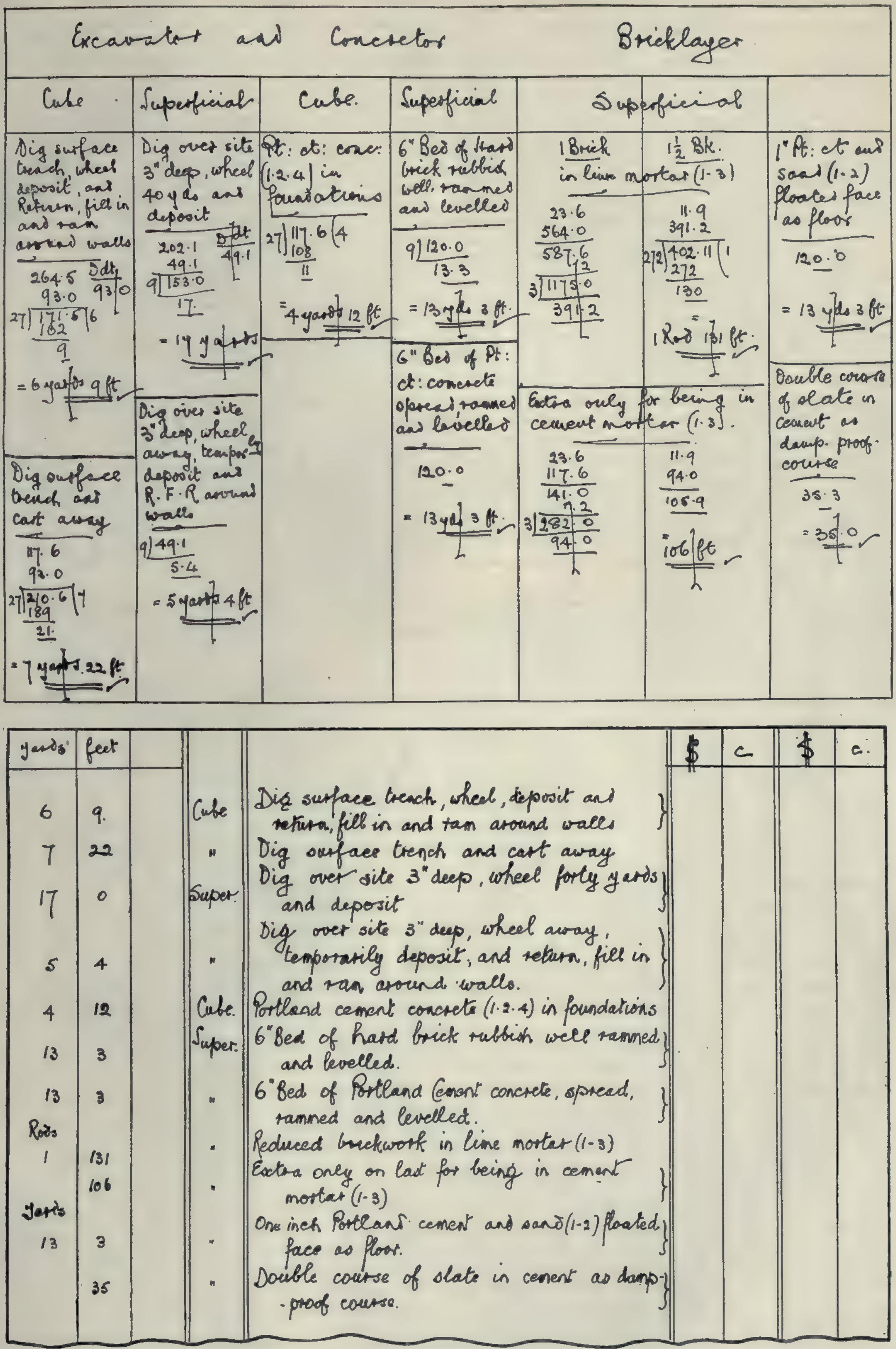
The walls are 10 ft. high above ground line.

The damp course to be a double course of slate in cement.

The cement concrete over site to be faced with one inch of Portland cement and sand (1-2).

In connection with the walls of a brick building it was desired to clean and brighten the terra-cotta dressings, the bricks being of a deep tan color, while the terra-cotta was of a light cream that had turned dark and was unsightly from many years' exposure. The "Painters' Magazine" says: "The simplest way to accomplish this is to mix 2 lb. of powdered pumice and 1 pint of liquid ammonia with 1 gal. of soft soap, applying the mixture to the surface to be cleaned with a fibre wall-brush, allowing it to remain about thirty minutes. Then rub briskly with a good scrubbing-brush. When on trial it shows that the compound has done its work, clean it off with lukewarm water by using a large sponge, and rinse, if possible, with a hose, otherwise with the sponge and a liberal supply of clear water. If after drying the terra-cotta appears dull it may be revived by rubbing it over with a cloth saturated with kerosene oil."

It has been found advisable in the highway work carried on in King County, Washington, to build the curves on brick pavements without crown. The usual super-elevation now being used on curves is about twice the crown prescribed for any given width, while the maximum super-elevation is 1 ft. for a 20-ft. roadway. The amount of super-elevation is not determined by the length of the radius, but rather by a number of other conditions, chief among which is the width of central angle. Owing to the fact that automobiles usually "cut corners" on a short curve, they swing around it on a larger radius than the centre line actually has, so that the super-elevation required on a short curve is less than that needed for one with a greater central angle. No drainage difficulties have been reported, and there is a general agreement among motorists that the elimination of crown makes the curve safer and easier to drive over at high speed.



Excavator and Concretor				Bricklayer		
Cube	Superficial	Cube.	Superficial	Superficial		
Dig surface trench, wheel deposit, and Return, fill in and ram around walls 264.5 Ddt. 93.0 93|0 27)171.5(6 162 9 = 6 yards 9 ft	Dig over site 3" deep, wheel 40 yds and deposit 202.1 Ddt. 49.1 49.1 9)153.0 17. = 17 yards	Pt: ct: conc: (1.2.4) in foundations 27)117.6(4 108 11 = 4 yards 12 ft	6" Bed of Hard brick rubbish well, rammed and levelled 9)120.0 13.3 = 13 yds 3 ft.	1 Brick in lime mortar (1-3) 23.6 564.0 587.6 2 3)1175.0 391.2	1½ Bk. 11.9 391.2 272)402.11(1 272 130 = 1 Rod 131 ft.	1" Pt: ct and sand (1-2) floated face as floor 120.0 = 13 yds 3 ft
Dig surface trench and cart away 117.6 93.0 27)210.6(7 189 21. = 7 yards 22 ft.	Dig over site 3" deep, wheel away, temporarily deposit and R.F.R around walls 9)49.1 5.4 = 5 yards 4 ft		6" Bed of Pt: ct: concrete spread rammed and levelled 120.0 = 13 yds 3 ft.	Extra only for being in cement mortar (1-3). 23.6 117.6 141.0 2 3)282.0 94.0	11.9 94.0 105.9 = 106 ft	Double course of slate in cement as damp-proof course 35.3 = 35.0

yards	feet				$	c.	$	c.
6	9.		Cube	Dig surface trench, wheel, deposit and return, fill in and ram around walls				
7	22		"	Dig surface trench and cart away				
17	0		Super.	Dig over site 3" deep, wheel forty yards and deposit				
5	4		"	Dig over site 3" deep, wheel away, temporarily deposit, and return, fill in and ram around walls.				
4	12		Cube.	Portland cement concrete (1.2.4) in foundations				
13	3		Super.	6" Bed of hard brick rubbish well rammed and levelled.				
13	3		"	6" Bed of Portland Cement concrete, spread, rammed and levelled.				
Rods 1	131		"	Reduced brickwork in lime mortar (1-3)				
	106		"	Extra only on last for being in cement mortar (1-3)				
Yards 13	3		"	One inch Portland cement and sand (1-2) floated face as floor.				
	35		"	Double course of slate in cement as damp-proof course.				

Estimating Methods.—At the top of the page is shown the abstract, and at the bottom what the author describes as the bill.

Concreting in Freezing Weather, and the Effect of Frost Upon Concrete*

THE engineer who is called upon to carry out work in Canada during the winter finds that the methods of construction which were satisfactory in the summer will need considerable modification to suit winter conditions.

Concrete work, especially the lighter forms of reinforced concrete, used in building construction needs greater care and supervision. As a result of considerable experience gained during the last few years, it can be said that the freezing of concrete will not damage it if it has first had a chance to set under favorable conditions for about two days. The effect of the freezing is simply to delay the process of hardening, which will again proceed under suitable conditions, and will eventually attain its full strength. If concrete is frozen before it has commenced to set, it will not be injured if precautions are taken to prevent it from freezing again after it thaws until it is sufficiently hardened to withstand the affects of subsequent freezings. It is alternate freezing and thawing during the process of setting that causes the damage.

To meet the foregoing conditions, when carrying out concrete work in winter, it is necessary to devise means of mixing the concrete with materials freed of frost, placing it in the forms before it has commenced to freeze, and then protecting it and keeping it warm without fear of its being damaged.

In the case of concrete in mass, of large bulk, it is unnecessary to apply external heat, as the large body of concrete will generate sufficient heat during the process of hardening to enable the mass to set; all that will be necessary is to protect the outside of the concrete so as to keep the heat in. This can best be done by covering the concrete with clean straw.

For light sections of concrete, such as in reinforced concrete, poured at a temperature not below 22 deg. Fahr., some engineers allow salt to be used in a proportion not exceeding 10 per cent. There are many arguments for and against its use. The author prefers not to use it, except in marine works when the concrete is mixed with sea-water and the salt is admitted in that form. He has found that, instead of using salt good results will be obtained for temperatures that do not fall below 22 deg. Fahr. by heating the water with a steam-hose taken from the mixer-boiler, and when necessary placing a few coke or wood fires on the heaps of sand and crushed stone, the usual precautions being taken to protect the concrete when in the forms, as described later.

For lower temperatures than those referred to above greater precautions must be taken to heat the ingredients by means of steam coils or radiators.

The concrete having been mixed, and the portion of the work to be carried out decided upon, the floor immediately below it should be partitioned off with tarpaulins, and coke stoves arranged under the floor slab, allowing about one stove to every 800 sq. ft. of floor space. All loose dirt and snow must be removed from the forms with brooms, and a steam hose should be applied to remove all ice and frost, the steam playing continuously over the forms in advance of the concrete, thus warming them in readiness for the concrete. The concrete should be poured quickly and continuously, and as each section is completed a tarpaulin may be drawn over it, supported on wooden strips about 6 inches above the surface of the concrete. In most cases this protection will be sufficient, but during very cold weather it will sometimes be found necessary to form a sort of tent over the floor, in which extra stoves are placed to protect the workmen and the upper surfaces of the concrete.

Great care must be taken to have the fires kept burning continuously for two days, after which the concrete may be allowed to freeze without fear.

The work must be examined from time to time until it is found to be hardened sufficiently. During summer working the author has allowed the supports from the underside of slabs to be removed in four days, but on other occasions four weeks have not been found to be too long.

There are many examples of concrete works which have stood the test of time without showing any signs of being affected by frost; but, on the other hand, a few cases have been reported of very serious corrosion due to the action of frost, such as bridge piers and reinforced-concrete piles.

Judging from the information available at present, concrete exposed in air in a dry locality need not be affected by frost any more than good building stone, and probably it will stand much better. Concrete always submerged under water is protected and need cause no anxiety. But concrete alternately wetted and frozen must be protected from frost. On work which is being carried out at Halifax, Mr. John Kennedy, M. Inst. C. E., is protecting the concrete piles between high and low water with a covering of wood about 2 inches in thickness, which it is hoped will prevent the action of frost.

The Evils of Indefinite Plans and Specifications

ADVOCACY of definite plans and specifications on either public or private work is no longer necessary, comments the Engineering Record, editorially. In theory it is recognized as desirable to give contractors all the information possible when asking for bids. Quantities should be as definite as possible, and alternative designs permitted only after careful consideration. If alternative plans are permitted, the restrictions should be such that it is possible to compare them.

While this is the theory, contractors cite instances without number of its violation in practice. Two very recent examples in neighboring cities furnish food for thought for those whose invitations to bidders are still indefinite. In the one case tenders were asked for the construction of a $300,000 sewer system. The contract form contained 55 pages of text, covering terms and conditions of the contract and the grade of materials and work required. Then followed a 15-page list of detailed quantities. This list did not attempt to show the amount of cement required, for example, but rather the number of cubic yards of concrete in each different sewer section per lineal foot. It enumerated the exact length of each type and size of sections for various depths and the amount of excavation, timbering and invert paving required on curves and tangents. Quantities in cubic yards were carried out to the third decimal place, and even the exact number of step-irons and their bolts was listed. Opposite each of the items listed there was left a blank in which the contractor was to fill in unit and total prices.

In marked contrast to this it is interesting to note that some time after tenders were asked for this sewer work a neighboring city called for bids on a reinforced-concrete structure for municipal use. There was some debate as to just what type of construction to adopt, so it was decided to leave the specifications somewhat indefinite and allow each bidder to submit his own design. When bids were opened it was found that twelve contractors had turned in a total of one hundred and twenty different tenders, each one for a different design, and all based on estimates which could not possibly have been worked out in fine detail. These tenders varied from $162,000 to $248,000 and, partially because it was impossible to compare them satisfactorily, no final action has yet been taken.

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* Abstract of paper read at a meeting of the Institution of Civil Engineers, Great Britain, by J. Hammersley-Heenan, Montreal.

The sewer work, on the other hand, has been under way for several months, the contract having been awarded shortly after bids were opened. After eliminating the highest and the lowest bidders in the sewer work the remaining five tenders were within 12 per cent. of one another, and on one varied more than 7 per cent. from the engineer's estimate.

There will be some criticism of the refinement in the case of the sewer specifications where preliminary calculations worked out concrete yardages per foot to the last thousandth, but such criticism only accentuates the moral in the comparison, for even with this extreme refinement the cost of getting out the specifications was only about one-tenth of 1 per cent. of the work.

B.C. Engineers in Session at Victoria

THERE was a representative gathering at the Third Annual Convention of the Victoria and Vancouver Branches of the Canadian Society of Civil Engineers, held at Victoria on December 11-12. The deputation from the mainland included Messrs. R. F. Hayward, Geo. A. Walkem, E. G. Matheson, A. D. Creer, H. Carry, E. A. Cleveland and J. H. Kennedy—headed by Mr. G. R. G. Conway, Chief Engineer of the British Columbia Electric Railway and Chairman of the Vancouver Branch.

The visitors were received by Mr. D. O. Lewis and Mr. R. W. Macintyre, Chairman and Secretary respectively of the Victoria Branch.

At a business session, held on the evening of Friday, December 11, a paper relating to harbor improvements was read by Mr. J. S. McLachlan, Resident Engineer of the Dominion Department of Public Works.

At the morning session on Saturday, December 12, the Chairman dwelt at some length on the status and responsibilities of the profession. It was gratifying to find that a clause had been inserted in the Provincial Water Act, defining the duties of the civil engineer. This constituted a certain amount of recognition of the profession.

A paper entitled "Legislation for the Engineering Profession" was read by Mr. G. R. G. Conway. In the ensuing discussion Mr. Walkem recalled the opposition encountered sixteen years ago in Manitoba and Quebec. Similar opposition might develop in British Columbia in the event of an attempt to introduce what would be termed "class legislation." Mr. C. H. Rust compared the position of medical men and lawyers. He considered that it would probably be inadvisable for engineers to attempt to form a close corporation. He held, however, that in the interests of the younger members of the profession some effort should be made along the line of a more strict definition of professional engineering status. Mr. Cavana referred to the attitude of the Victoria and Vancouver Branches on the question of legislation. He thought that they were rather opposed to the idea of forming a close corporation, but that they considered the time ripe to ask the legislature for an authoritative declaration as to what an engineer really was. Mr. Gamble held that the profession required only a proper recognition of the meaning of the term "Engineer." He held that some standard definition should be incorporated in the Interpretation Acts of the province. Mr. Walkem complained of the action of the Eastern provinces in attempting to combine the whole profession and to define all branches of engineering in one term—an impossible task.

Mr. Hayward urged those present to emulate the example of the Institution of Civil Engineers (Great Britain), which had been established in its position of prominence by prestige and precedent. Canadian societies should follow the Old Country example in so treating the ethics and practice of their profession that their work would be placed in the highest classification. Legislation would not effect more than the highest practice of the profession by the members. He agreed with the view that a comprehensive definition of the term "Engineer" was very desirable.

Both Mr. A. D. Creer and Mr. H. Carry advanced a plea for the strict observance of professional etiquette at all times.

Mr. E. G. Matheson alluded to the attitude of the American Society of Civil Engineers on the subject of legislation. While he was in sympathy with the views of previous speakers he felt that an established definition of the profession would produce a feeling of confidence and security when public work was being given out. The public should be trained to believe in the Canadian Socety. On the other side of the line the services of the engineer were being placed on a higher plane.

Messrs. Macintyre, Gamble and Young also took part in the discussion. Mr. Young advocated that an effort should be made to obtain the recognition of the University of British Columbia. He thought that some engineering degree might be adopted by the University Council.

A private business session was held on the morning of Saturday, December 12, while on the afternoon of the same day the members were the guests of Mr. H. A. Elgee, local manager for Sir John Jackson, Limited. A trip was made to the Albert Head Quarries, where the stone for a large new breakwater is being secured. A blast was fired in order that the visitors might note the effect produced by the heavy charge of explosives.

At the annual banquet on Saturday evening the attendance numbered nearly one hundred. The guests included Mr. G. H. Barnard, M.P.; Hon. Dr. Young; Mr. H. H. Watson, M.O.A.; Mr. H. B. Thompson, M.L.A.; Mayor Stewart and Col. Oglivie. Letters of regret were received from Sir Richard McBride, Premier of British Columbia, and from Hon. Wm. R. Ross, Minister of Lands.

The following gentlemen, resident in Canada, have been elected to Associate Membership in the American Society of Civil Engineers:—Mr. G. W. Harris, Port Arthur, Ont. (Office Engineer, Mackenzie, Mann & Company, Limited); Mr. C. S. Millard, Vancouver, B.C. (Manager and Chief Engineer for Mr. Francis S. Swales, architect); Mr. L. R. Thomson, Montreal, Que. (Designer, Dominion Bridge Company, Limited).

Personal Mention

Mr. J. S. MacLachlan, Dominion Government Engineer, read a paper on Harbors at a recent meeting of the Victoria Branch of the Canadian Society of Civil Engineers.

Mr. Mercier, the assistant engineer of the Montreal Council, will act as chief engineer during the absence of Major G. Janin, the chief engineer, who has volunteered for the front in command of a corps of engineers.

Mr. Percy E. Jarman has been appointed City Engineer of Westmount, P.Q. Mr. Jarman has been acting engineer for nearly two years. Formerly he was assistant to Mr. Archibald Currie, then City Engineer of Ottawa.

Mr. J. E. Putnam is senior member of the new engineering and architectural firm of Messrs. J. E. Putnam & Company, Indianapolis, Ind. He is associated with Mr. W. C. Thayer, at one time Chief Draughtsman for the General Electric Company, at Peterborough, Ont., and later Assistant Engineer on the construction of the Niagara Falls hydro-electric power plant.

Mr. Fred M. Hoadley, consulting engineer, 802 New Birks Building, Montreal, has been commissioned by the Bishop of the Monastery at Oka, Quebec, to make a complete investigation into the possibilities of developing a hydro-electric plant upon the river running through the property adjacent to the Monastery for the purpose of generating power and lighting.

Mr. A. W. E. Fawkes has resigned as Water-Works Engineer of Calgary, to open an office in the Burns Building, Calgary, as consulting engineer. Mr. Fawkes will specialize in water-works, filtration plant, sewer and other municipal engineering works. He is also prepared to undertake gas, water and electrical appraisal, supervision and inspection. Mr. Fawkes began his engineering experience in England and was for a time assistant engineer for the British Government. Later he was chief engineer of construction for Messrs. Vickers, Sons & Maxim, in England. After coming to Canada, he was engaged in hydro-electrical power development at Campbellford, Ont., resident engineer for the city of Peterborough, Ont., on dam, pumping station and water-works construction, chief assistant engineer of construction on the Minneapolis filtration plant, engineer in the Bridge Department of the Chicago, Milwaukee & St. Paul Railway, and Water-Works Engineer at Calgary. Mr. Fawkes is a Member of the Institution of Municipal Engineers, the Institution of Engineers, the Institution of Water Engineers, the Institution of Municipal and County Engineers, all of England, and also of the American Water-Works Association and the International Congress of Engineering.

Mr. A. J. T. Taylor, for two and one-half years a member of the firm of Taylor & Young, Limited, engineers, Vancouver, recently severed his connection with that firm to become Managing Director of the Taylor Engineering Company, Limited, engineers and machinery merchants, with offices in the Vancouver Block. The firm, which is backed by ample local capital, will specialize in pumping and power plant equipments of the best types, which will be designed, tested and handed over under guarantee. The new firm has already taken on several good-sized contracts, and will be heard from later on when returning prosperity sets the wheels of industry moving.

"The Business Ethics of the Engineer" was the subject of an address delivered recently before the Engineering Society of Queens University, Kingston, by Mr. G. G. S. Lindsey, K.C., President of the Canadian Mining Institute.

Canadians in Chicago

The following were among the Canadians in attendance at the convention of the American Road Builders' Association, held in Chicago, December 14-18:—Mr. J. K. Allen, Toronto (General Manager, Rocman Roads Company); Mr. E. H. Armstrong, Halifax, N.S. (Minister of Public Works); Mr. Wm. Barber, Toronto (Superintendent of Construction); Mr. E. Brian, Windsor, Ont. (City Engineer); Mr. W P. Brereton, Winnipeg, Man. (City Engineer); Mr. Arthur E. D. Bruce, Toronto (Secretary, Northern Road Department, Provincial Government, Ontario); Mr. M. Calder, Edmonton, Alta. (Inspector of Public Works); Mr. Miles P. Cotton, Vancouver, B.C. (Contractor); Mr. W. S. Davis, Toronto (Toronto & Hamilton Highway Commission); Mr. J. W. Evans, Belleville, Ont. (City Engineer); Mr. Frank Goodman, Toronto (Jennison-Wright Company, Creosoters); Mr. Andrew W. Gray, Ottawa, Ont. (Dominion Parks Highway Engineer); Mr. W. H. Hall, Oshawa, Ont. (Corrugated Metal Culverts; Mr. Geo. S. Henry, Toronto (Secretary and Treasurer, Ontario Good Roads Association); Mr. H. C. Hocken, Toronto (Mayor); Mr. John J. Jackson, Niagara Falls, Ont. (General Superintendent, Queen Victoria Park System); Mr. E. A. James, Toronto (Consulting Engineer); Mr. Frank H. Keefer, Thorold, Ont. (President, Rocmac Company); Mr. Hugh A. Lumsden, Toronto (Public Works, Provincial Government of Ontario); Mr. F. G. Macdiarmid, Toronto (Ontario Public Works Department); Mr. H. A. Mackai, Toronto (Rocmac Roads); Mr. S. V. Martin, Bruce Mines, Ont. (President, Martin International Trap Rock Company); Mr. Geo. A. McNamee, Montreal (Secretary and Treasurer, Dominion Highway Association); Mr. W. A. McLean, Toronto (President, American Road Building Association); Mr. Frank Menzie, Niagara Falls, Ont. (President, Glutrin Road Construction Company); Mr. J. F. Mitchell, Windsor, Ont. (Superintendent, Canadian Dolorway Paving Company); Mr. Geo. Michaud, Three Rivers, Que. (Contracting Engineer); Mr. Chas. Moogk, Waterloo, Ont. (Town Engineer); Mr. Geo. Moogk, Weston, Ont. (Municipal Contractor); Mr. A. M. Rankin, Toronto (Commissioner of Public Roads and Highways); Mr. Thos. E. Riley, St. Catharines, Ont. (Contractor); Mr. J. D. Robertson, Edmonton, Alta. (Engineering of Highways); Mr. J. D. Scholfield, Toronto (representing Rocmac Roads); Mr. F. A. Senecal, Plantagenet, Ont.; Mr. H. J. Stambaugh, Jr., Walkerville, Ont. (Trussed Concrete Steel Company); Mr. S. L. Squire, Waterford, Ont. (Ontario Good Roads Association); Mr. Murray A. Stewart, Toronto (Assistant Engineer, Roadway Section); Mr. John Stocks, Edmonton, Alta. (Deputy Minister Public Works); Mr. W. F. Tallman, Winnipeg, Man. (Street Commissioner).

In the article relating to the Central Technical School, published in our issue of December 16th, mention should have been made of an important installation—the vacuum cleaning system. This equipment (known as the "Tuec") was furnished by the United Electric Company through Mr. J. J. Martindale, Toronto, distributing agent for Ontario. The installation comprises two four-sweeper TUEC stationary vacuum cleaners—making an eight-sweeper capacity installation in all. This means that the cleaning system can be used simultaneously by eight persons. An idea of the facility of operation is conveyed by the fact that throughout the building approximately 280 valves will be installed. Thus there are 280 places where the hose can be attached to the piping system. The dirt and dust are delivered through the piping system to machines in the basement from which they will be taken away periodically and burned. The air which does the work is discharged outside of the building, thus assisting in the ventilating as well as the cleaning of the rooms.

LETTERS

Editor Contract Record:

In an article on page 1385 of the Contract Record, November 11th, 1914, it is claimed that the first successful effort to stop the flow of water through fissures was carried out on the Catskill Aqueduct. The writer used this method in 1909 to seal the wall of water-tight cellars for the White Hall Building, New York City. The head of water was slightly under thirty feet, but the principle is the same. Some of the concrete forming the peripheral wall, it having been placed under adverse conditions, developed several serious leaks. Indeed, while there was no single leak of large dimensions, a 6-inch centrifugal pump was required to keep the cellar dry, and the owners doubted the ability of the contractor to overcome the trouble.

The writer suggested, and had performed under his directions, the injection of grout until the work was accepted by the owners. The surface of the concrete where defective, was cut out to a depth of about 5 inches, three-inch plank was set into this place, strongly braced and calked. A two and one-half inch pipe was placed through this plank, with a flange inside and a valve on the outside. Through this the water flowed while preparations were under way. When all was ready the discharge of a Douglas grout pump was attached; and cement grout was pumped in under pressure. No sand was used, as it was essential that no cavity, however small, should remain unfilled. A pressure upwards of 150 pounds was developed and maintained until no more could be forced in, when the valve was closed and the pump attached to another point of attack. The method proved entirely successful. The writer has used the same method several times, both previously and subsequently.

Yours truly,

E. G. Matheson.

An Important Judgment

THE Railway Commission has just given a decision on the special provision for the carriage of brick in carload lots, in which the shippers gained their point. The judgment is as follows:—

"Upon the hearing of the matters at the sittings of the Board held in Ottawa, November 26th, 1914, in the presence of counsel and representatives of the railway companies, and representatives of the complainants, the Canadian Manufacturers' Association, and the Toronto and Montreal Boards of Trade, and what was alleged, and upon the recommendation of the chief traffic officer of the board,

"It is ordered, with respect to the tariffs of railway companies subject to the jurisdiction of the board and operating in Eastern Canada, as follows, namely:

"(a) That wherever it occurs, the provision of a minimum weight of 50,000 pounds per carload of building brick, other than enamelled or glazed brick, be supplemented to provide that should a car of the loading capacity of 40,000 pounds be ordered which the carrier is unable to furnish within a reasonable time, a car of greater capacity shall be furnished and charged for on the basis of the actual weight of the brick loaded therein, subject to a minimum of 40,000 pounds; but that should such a car so furnished be loaded in excess of 45,000 pounds the minimum weight assessable for freight charges shall be 50,000 pounds.

"(b) That whenever it occurs in the special tariffs applicable on brick, stone, and other commodities commonly described in the tariffs as 'building material,' the provision for an increase of 5 per cent. per foot to the tariff minimum weight in the case of cars longer than those covered thereby, be withdrawn and cancelled.

"(c) That effect be given to this order not later than December 21st, 1914."

The commissioners also decided that the C. P. R. must cancel their order putting an embargo on carloads of brick, lumber, etc., coming from C. N. R., Grand Trunk, and Intercolonial points for delivery on the C. P. R. team tracks at Mile End, Montreal. The C. P. R. alleged that it was impossible to deal with this traffic owing to congestion.

An Interesting War Talk

On the evening of Friday, December 18, the members of the Engineers' Club of Toronto were entertained to an interesting and unprecedented feature in the shape of a talk about the European war, by a French Army Officer who had fought in the thickest part of the conflict and survived serious wounds.

The speaker was Lieut. de la Haie de Silz, of the Third Chasseurs a Cheval, and the subject of his address was: "My experiences in the War from Nancy to Armentieres."

The gathering, which included a number of officers of the local militia, numbered some one hundred and fifty. Mirrorscope views of scenes and incidents in the theatre of operations enhanced the interest of the address.

The speaker was introduced to the members by Colonel Van Nostrand, President of the Club, who presided over the meeting.

Lieut. Silz opened his remarks by recounting his experiences from the date of mobilization early in August to the developments which culminated in the battle around La Bassee, in which his regiment participated. So heavy was the fighting in this engagement that Lieut. Silz and six men were the only survivors of a whole regiment.

The account of the German spying system, particularly that portion relating to the ruses employed by the enemy for the purpose of locating the presence of the Allies, was an interesting feature of the address. The speaker compared the arrogance of the German officer, and the perpetual fear of the German soldier, with the spirit of camaraderie existing between the officers and men of the French army. The speaker received an ovation upon declaring that in the western theatre of the war, the Allies' artillery was superior to the enemy's. Lieut. Silz gave a vivid description of the work of his regiment undertaken on behalf of an imperilled Belgian division. For his own personal part he was presented with a sword by the King of Belgium. The sword was exhibited and passed around the audience.

The speaker referred to the German Emperor as "His Most Ignominious Majesty," and recited his experiences of the atrocities and indignities perpetrated by the Germans.

At the conclusion of his address, Lieut. Silz was plied with many questions bearing upon matters of administration, equipment, service and regulations in the French army. He reminded those present that in France every man between the ages of eighteen and forty-eight was in uniform and in actual training.

The proceedings closed with a vote of thanks to the speaker and cheers for France and the French nation.

A Vancouver despatch states that the city recently incurred a loss of 3,000,000 gallons of water a day—one-fifth of the normal supply, owing to a break in the 18-inch water main across Burrard Inlet, caused by the dragging of an anchor of some vessel.

Mainly Constructional

East and West—From Coast to Coast

The Medicine Hat Planing Mills, Limited, have sustained a loss of $10,000, through the destruction by fire of their lumber mill.

At Niagara Falls, Ont., a by-law is to be submitted to the ratepayers in January, to authorize the construction of a sewer in the vicinity of Muddy Run Creek. The work is estimated to cost $200,000.

St. John, N.B., is the head office of a newly-incorporated firm, the Colonial Construction Company, which is capitalized at $24,000. The incorporators include Messrs. Murray W. Long and H. Colby Smith, St. John contractors.

The Hamilton Bridge Works have the contract for the steel work in connection with the Don Section of the Bloor Street Viaduct, for which the general contractors are Messrs. Quinlan & Robertson. The steel work will run into some $400,000.

At Vancouver, B.C., work will be started shortly on the interior of the new Immigration Building, which has reached the roofing stage for the Dominion Government Department of Public Works. The estimated cost of the structure of $350,000.

At Vancouver, B.C., the Burrard Inlet Tunnel & Bridge Company have awarded the contract for the construction of a steel and concrete bridge, 225-ft. centre span, to the Canadian Bridge Company, Walkerville, Ont., the contract price being $1,846,000.

The Vancouver District Joint Sewerage and Drainage Board are proceeding with the construction of a trunk sewer in Central Park, at an estimated outlay of $300,000. The general contract for the work is in the hands of Messrs. Hodgson, King & McPhalen Bros.

The annual meeting of the Canadian Car & Foundry Company, Limited, which was called for December 21 at Montreal, has been postponed until Monday, February 8. The president of the company, Hon. Nathaniel Curry, is at present in London, Eng., and his return is not expected until some time in January.

The Renfrew Machinery Company have been awarded a contract for the manufacture of a large quantity of shells for the British War Office. It is stated that the order will be sufficient to keep the factory running day and night for a period of about six months. Ordinarily the company are manufacturers of cream separators.

In the District of Algoma, Ont., about 32 square miles of timber land on Batchawaung Bay, Tilley, Archibald and Tupper townships, have been purchased by Messrs. Wells-Higman Company, St. Joseph, Mich., who are contemplating the construction of 474 ft. of docks. A shingle mill, saw mill and veneer plant will also be erected.

The Hudson's Bay Terminal and Harbor Works at Port Nelson, B.C., are progressing satisfactorily, according to a report made recently by Mr. D. W. McKughlin, Engineer-in-Charge. He has just returned to Ottawa, after an absence of nearly two years on the work, and his mission is to discuss further plans for the coming year.

An order for the manufacture of 120,000 shovels for the British War Office has been placed by Mr. Frederic Stobart, Purchasing Representative, with two Canadian firms—the Jones Shovel Company, of Gananoque, Ont., and the Hamilton Shovel Company, Hamilton, Ont. Both these firms have divided the order which is estimated to be worth more than $50,000. The shovels are to be delivered in weekly shipments.

The Westmount Council electric lighting department made a profit of $30,400 during the last fiscal year. This has been turned into the depreciation fund, now amounting to $147,000, from which amounts needed for the improvement of the system are voted. A sum of $25,000 has been drawn from this account for the extension of a new street lighting system.

At Quebec, Que., the Canadian Pacific Railway Company have at present in course of construction important additions to their freight sheds at that point, estimated to cost $300,000. The buildings will be one-storey, 30 x 368 ft., 50 x 593 ft., brick and reinforced concrete construction. Downing-Cook Construction Company, Montreal, are the general contractors.

The Montreal municipal controllers have voted $1,500 for work on the plans of a tunnel under the Lachine Canal at Wellington Street bridge. The tunnel, plans for which are being drawn by Mr. McLeod, municipal and tramways engineer, is estimated to cost $750,000. It will be at least 45 feet below the surface of the canal, and will obviate delays to traffic due to the frequent openings of the bridge to allow shipping to pass through the canal.

The city council of St. Catharines, Ont., have awarded the contract for the steel superstructure for St. Paul's street high-level bridge, to the Canadian Bridge Company, of Walkerville. The contract price, $91,000, includes the supplying of rails and track fittings, buckle plates and 300,000 lbs. of extra steel, which latter will be required in connection with the projected Hydro-Electric Railway. It is said that the tender was $20,000 below the engineer's estimate.

Notwithstanding the financial stringency which characterized the past year, the annual report submitted to the Civic Works Committee of Toronto city council by Mr. R. C. Harris, Commissioner of Works, disclosed the information that more than $10,000,000 has been expended on various public works during the last twelve months. This sum was distributed as follows:—Roadways, $3,538,002; sewers, $2,972,480; waterworks, $2,194,512; railways and bridges, $729,518; marine works, $26,265; miscellaneous, $1,445,405. During the year 89.90 miles of sewers were commenced, and 60.7 miles completed. Forty-two miles of pavements and 54 miles of sidewalks were laid, and 55 subways constructed in connection with the North Toronto grade separation. Twenty-six miles of water mains were laid, twenty-two street corners rounded, and eleven streets extended.

Reports from Ottawa would indicate that the war is not to be allowed to interfere with railway construction work in Canada. It is expected that several bills seeking new railway charters and extending the charters of lines already existing, promise to be in evidence during the approaching session. The Kettle Valley Railway will apply for permission to extend the time within which the following lines of railway, all in British Columbia, may be constructed: Summer Creek or One-Mile Creek, to Copper Mountain and Voigt Mining Camps; from Vernon to Penticton via Kelowna; from Penticton to Ozoyoos Lake; from Summer Creek to Allis or Princeton, thence to Granite Creek coal areas; from Grand Falls to a point fifty miles up the North Fork of Kettle River; from Midway to Hedley, and from Penticton to Nicola. The Western Dominion Railway Company of Calgary will apply for the usual extension of time in which to construct its authorized lines. The Brule, Grand Peace River Railway Company will seek a Dominion charter, giving it the right to construct railway, telegraph and telephone lines, commencing at a point in Alberta at Brule Lake, on the main line of the Grand Trunk Pacific and Canadian Northern Railways, northwesterly to Grand Prairie, thence northwesterly to a point in British Columbia, connecting with the terminus of the Pacific and Great Eastern Railway at or within the Peace River block; also commencing at Grand Prairie northerly to the Pacific, Peace River and Athabasca Railway at or near the point where the railway crosses the Montagneuse River, passing at or near Spirit River settlement, and crossing the Peace River at or near Dunvegan, approximately 400 miles in all.

American Concrete Institute

As already announced in these columns, the Eleventh Annual Convention of the American Concrete Institute will be held at the Auditorium Hotel, Chicago, from February 9th to 12th, 1915. This meeting will mark the completion of the tenth year of the existence of the Institute, and a specially interesting and profitable programme is being arranged.

On the opening day, Tuesday, February 9th, there will be important papers and discussions relating to the status of concrete road construction, with reference particularly to the cost of construction, and of maintenance and repairs. On the second day, Wednesday, February 10th, there will be a discussion on tests and matters bearing upon design in concrete. At least one session on Thursday, February 11th, will be devoted to concrete in art and architecture—special attention being given to the treatment of surfaces, and the more practical phases of the subject. On the Thursday evening there will be the annual banquet, which will offer attractions of varied interest.

The closing day, Friday, February 12th, will be given over to papers covering plant management and costs, the design and cost of wood and metal forms, and the method of placing, proportioning and selecting concrete materials.

Committees of the Institute will present reports on the following subjects:—Concrete Roads—Revised Specifications; Concrete Highway Bridges and Culverts—Foundations, design and construction; Concrete and Reinforced Concrete—Results of tests on 24 columns 20 ins. diameter and 12 ft. long; Nomenclature—Proposed standard notation; Insurance—Present conditions effecting the fire insurance of concrete structures; Cement Products—Recommended Practice and Specifications for Cement Drain Tile; Treatment of Concrete Surfaces—Stucco specifications on wood lath and dustless floors; Methods of Tests and Standard Specifications for Concrete Materials—Tests of aggregates and test pieces.

The Secretary of the American Concrete Intsitute is Mr. E. E. Krauss, of Philadelphia, to whom we are indebted for our information.

The following lectures have been delivered recently before the graduate students in Highway Engineering at Columbia University:—"Specifications for Sizes and Physical Properties of Broken Stone," Mr. Arthur W. Dean, Chief Engineer, Massachusetts Highway Commission, Boston (December 3); "The Essential, Physical and Chemical Properties of Creosote Oils for Wood Blocks," Mr. Sumner R. Church, Manager, Research Department, Barrett Manufacturing Company, New York (December 7); "Details of Construction of American Wood Block Pavements," Mr. A. W. Dow, Chemical and Consulting Paving Engineer, New York (December 6); "European Wood Block Pavements," Mr. George W. Tillson, Consulting Engineer to the President of the Borough of Brooklyn, New York (December 11).

Erratum—In the article relating to the plant of Messrs. Canadian Vickers, Lmited, published in our issue of December 9 last, the Herbert Morris Crane & Hoist Company, Limited, was referred to as being located in England; whereas the head office of the company is in Toronto (Mr. Malcolm Meldrum, General Manager). The firm has no branches outside of Canada.

Sewage Pumping Equipment at Chilliwack, B.C.

The City of Chilliwack, B.C., is at present constructing a complete sewerage system. As this city is situated on a level tract very little above the high-water mark of the Fraser River, it has been necessary to install a pumping plant to dispose of the sewage.

The pumping equipment includes three 3-in. Byron-Jackson vertical centrifugal pumps, bottom suction, equipped with brass open runners and brass shafting. The pumps are so designed that none of the bearings can come in contact with the sewage, and the self-oiling thrust bearings are placed inside the motor bases where they are easily accessible. With this arrangement it is unnecessary to withdraw the entire unit to raise the sump cover when it is desired to examine the bearings. On each pump is mounted a 5 h.p. type U. H. Fairbanks-Morse vertical induction motor, 220 volts, 60-cycles, 3-phase, 1,200 r.p.m., being direct connected through a flexible coupling. Each motor is equipped with two sets of radial ball bearings and a ball thrust bearing to take the weight off the rotor. Bearings are of the Shefko self-aligning type and each bearing is independently lubricated by an improved automatic oiling system whereby the flow of oil can be seen at all times. The rotors are of the indestructible type, built with cast-on-end rings.

The capacity of each unit is 200 Imperial gallons against a total head of 33 ft. The bottom part of the sewage chamber is divided into two sections. In one section the sewage collects and is led to the pumps through the dividing wall. The pumps themselves are dry and accessible at all times, but being set below the level of the sewage they are practically submerged so far as priming is concerned.

An automatic float switch is provided to each motor, and a control panel installed, by means of which any motor may be connected to any one of the three controls or disconnected from the system at will. A maximum of flexibility is thus possible. The service is a 3-wire lead covered cable run from the Power Company's transformers carried underground in conduit to the motors.

Messrs. Cleveland & Cameron, of Vancouver, are consulting engineers for the city, and the pumping equipment has been supplied and installed by the Canadian Fairbanks-Morse Company, Limited, of Vancouver.

Before the members of the Victoria and Vancouver Branches of the Canadian Society of Civil Engineers, Mr. J. S. MacLachlan, Resident Engineer of the Dominion Department of Public Works, read a paper recently on "Harbors," with special reference to harbor works at Victoria, also the breakwater and piers now under construction.

The record of improvements effected on the Dominion Atlantic Railway, which the Canadian Pacific Railway leased in 1911 for 99 years shows that new wharves have been built; 45 miles of new track have been ballasted; 30 miles of new 85 pound rails have been laid down; 120 cattle guards have been filled and replaced by surface guards, while dozens of bridges have been either improved or rebuilt. In round figures, 6,000 feet of wooden bridges have been replaced, or will be replaced very shortly, by steel bridges, concrete arches, and rail top culverts. New brick stations have been built. A general renovation has taken place, costing mony thousands of dollars. The new stations include those at Wolfville and Annapolis Royal, Mosherville, Patterson and Iberville. During the past two years 35 stations have been repaired and painted, and platforms have been erected. A new line from Centreville to Weston, 14 miles in extent, has been built.

Contracts Department

News of Special Interest to Contractors, Engineers, Manufacturers and Dealers in Building Supplies

Waterworks, Sewerage and Roadways

Fernie, B.C.
The town council and the Canadian Northern Railway have been authorized to construct a subway on Cox Street, 7 ft. 6 in. high and 8 ft. wide. Mr. Wm. Ramsay is town engineer.

Fort William, Ont.
The ratepayers of this city will vote on a by-law shortly, to authorize the raising of $18,000 for the purpose of paving a subway completed by the Canadian Pacific Railway recently. Mr. Ray R. Knight is the engineer.

The ratepayers of this city will vote on a by-law at next municipal elections to authorize the expenditure of $65,000 on waterworks extensions. Mr. Ray R. Knight is city engineer.

Huntingdon, Que.
Tenders will be received by Mr. R. S. Feeny, secretary-treasurer, Municipal Council, until January 2, for macadamizing with sand stone finish various roads in this Municipality.

Hull, Que.
The city council is contemplating the expenditure of $200,000 upon the installation of an 8,000,000-gallon turbine pump and extensions to water mains, in this city. Mr. J. A. Laforest is city engineer.

Hamilton, Ont.
Work has been started by day labor upon the construction of a storm overflow sewer system, at an estimated outlay of $300,000. The city engineer is Mr. A. F. MacCallum.

Montreal, Que.
The general contract to erect a pumping station here, at an estimated cost of $5,500, has been awarded by the city council to Mr. T. F. Dwyer, 414 Merchants Bank Building. The contract for roofing will be sub-let by the general contractor.

Ottawa, Ont.
The city council has started work by day labor on surface drainage in connection with the laying of asphalt pavement between Preston Street and Viaduct, at an estimated cost of $8,000. Mr. F. C. Askwith is city engineer.

Surface drainage work has been commenced by day labor in connection with $20,000 pavement scheme on O'Connor Street. Tenders are now open for balance of work.

Parkhill, Ont.
The ratepayers of Parkhill will vote on January 4th on a by-law submitted by the town council to authorize the expenditure of $3,000 for extension to water-works. Mr. John N. Groves is the town clerk.

Port Hope, Ont.
Plans are being prepared by Messrs. Smith & Smith, Colborne Street, Lindsay, engineers-in-charge, for laying 4,000 ft. of sewers, of which 3,000 ft. will be a trunk sewer, to serve the westerly section of this city south of Rideau Street. Mr. R. Gray is secretary of the town council.

Toronto, Ont.
The Board of Control has decided not to open bids for Section 2, high level interceptor, and cast and steel pipe for same, until January 19th.

Watford, Ont.
The ratepayers of this village will consider a by-law on January 4, seeking to authorize the construction of a vitrified tile drain in the northern part of the village, at an estimated outlay of $5,000. Mr. B. B. Dann is the clerk.

Winnipeg, Man.
Tenders will be received by Mr. S. H. Reynolds, Commissioner, Greater Winnipeg Water District, 901 Boyd Building, for all labor, material, etc., required in the excavation of a channel between Indian Bay and Snowshoe Bay (arm of Shoal Lake).

Waterloo, Ont.
The town council is starting work shortly upon the construction of three miles of macadamizing, 16 ft. wide, estimated to cost $27,000. The work will be done by day labor. Mr. J. A. Perras is Asst. Secretary-Treasurer.

CONTRACTS AWARDED

Montreal, Que.
The contract for erecting a bridge 20 x 200 ft. across Vinet Street has been awarded by the Thos. Davidson Manufacturing Company, 187 Delisle Street, to the Dominion Bridge Company, Lachine, Que., at $2,000.

Strathclair, Man.
The Municipality of Strathclair has let the contract for the construction of two bridges over Wolfe Creek to Mr. Duncan Buchanan, Basswood, Man., at $577. The bridges are to be completed by March 1st.

Toronto, Ont.
The Board of Control has awarded the following contracts for sewer construction:—McLaren & Company — Merrill $416, Stacey $483; Mr. F. Angotti—Stanton, $2,400; Routly & Summers—Sproatt $1,080; Provincial Contracting Company —Roseheath $1,145, Bastedo $1,563; Orpen Company, Limited—Rosepark $1,635; Connolly Agnew Company — Keswick Drainage System $8,000; J. McGuire—Concord Avenue $885; McKnight Construction Company—Earlham $696; Commissioner of Works—Delaware Avenue $650, Glendu $535, Sawden $195, Ridge $4,350.

Railroads, Bridges and Wharves

Guelph, Ont.
The Guelph Radial Railway Company have been authorized to construct an extension to their Street Railway system, consisting of a single-track line on Suffolk Street. Mr. A. H. Goshi is the Superintendent and General Manager.

Hamilton, Ont.
Bridge plans have been approved by the Hamilton Bridge Company for high level bridge which will probably be erected under the supervision of Toronto-Hamilton Highway Commission, at Carroll's Point, at an estimated cost of $327,000. It was erroneously stated in our issue of December 9 that concrete plans were to be submitted by the Canada Cement Company.

Kaslo, B.C.
The location of a new station to be erected at Kaslo has received the approval of the Railway Board of Commissioners. The owners of the station will be the Canadian Pacific Railway.

Lindsay, Ont.
The Grand Trunk Railway Company have been authorized to construct a siding into the premises of Horne Bros., Woollen Mills.

Montreal, Que.
The Canadian Northern Railway has been authorized to construct a railway siding into the premises of Thos. Davidson Manufacturing Company, Limited.

Mitchell, Ont.
The chairman of the building committee, Mr. W. R. Cole, will purchase interior fittings for new school building, two-storey, 102 x 70, eight rooms, brick construction, for the School Board.

Norwich, Ont.
The Railway Board of Commissioners has approved of the location for a new G. T. R. station at Norwich; also for the construction of tracks across Main St.

Province of Alberta.
The Canadian Northern Railway has been authorized by the Railway Board of Commissioners to construct a spur to serve Glocum Howland Coal Properties on Sec. 9, Twp. 29.

Stratford, Ont.
The Board of Railway Commissioners has authorized the Grand Trunk Railway to construct a siding to serve the Stratford Chair Company, Limited.

Baggage room and office belonging to the Grand Trunk Railway Company at this city have been damaged by fire to the extent of $3,500.

Toronto, Ont.
The board of control has referred the following tenders for the Rosedale Section of Bloor Street Viaduct. to Mr. R. C. Harris, Commissioner of Works, for examination and report:—(1) $312,458.03; (2) $351,512.31; (3) $371, 019.18; (4) $417,947.49; (5) $384,663.77; (6) $476,587.92; (7) $310,515.74.

Classified Index of Editorial Contents for 1914

BIOGRAPHICAL AND PERSONAL

Title of Article	Issue	Page
J. G. White & Company, Ltd., London and New York.	Jan. 7	25
Mr. H. Talbot-Crosbie, Yorkton, Sask.	Jan. 7	26
Mr. J. M. Butler, Montreal	Feb. 18	213
Mr. George D. Mackie, Moose Jaw	Mar. 25	374
Mr. E. D. Gray, Toronto	Mar. 25	374
Mr. George Smith, Midland, Ont.	Apr. 15	469
Mr. W. Hollingworth, Hamilton, Ont.	May 20	653
Mr. L. B. Merriam, Winnipeg, Man.	June 3	729
Mr. R. C. Dancy, Toronto, Ont.	June 3	729
Mr. Donald A. Andrus, St. Catharines, Ont.	June 10	760
Lt.-Col. H. N. Ruttan, Winnipeg, Man.	June 24	822
Mr. A. J. Latornell, Edmonton, Alta.	June 24	823
Mr. F. P. Adams, Chatham, Ont.	July 1	853
Mr. W. Hartley Patterson, Victoria, B.C.	July 1	853
Mr. B. J. Arnold, Chicago, Ill.	July 8	879
Mr. J. W. Evans, Belleville, Ont.	July 8	880
Prof. E. E. Brydone-Jack, Winnipeg, Man.	July 8	880
Mr. E. A. Richardson (President Richardson Builders, Limited), Saskatoon, Sask.	July 8	881
Mr. G. T. Clark (Vice-President Richardson Builders, Limited), Saskatoon, Sask.	July 8	881
Mr. D. H. Mapes (Supt. of Building Construction, Canadian Pacific Railway), Montreal	July 15	914
Sir Alexander Binnie, London, Eng.	July 15	914
Mr. J. L. Busfield, Montreal, Que.	July 22	944
Dean Galbraith—Obituary	July 29	972
Mr. S. M. Brookfield, Halifax, N.S.	Aug. 5	1002
Mr. M. J. Haney, Toronto, Ont.	Aug. 12	1032
Mr. W. W. Pearse—City Architect of Toronto	Aug. 19	1061
Mr. J. B. Carswell, Toronto, Ont.	Sept. 2	1119
Mr. A. D. Creer, Vancouver, B.C.	Sept. 2	1119
Mr. R. W. Brock, Vancouver, B.C.	Sept. 2	1120
Mr. John W. Doty, Montreal, Que.	Sept. 16	1175
Dr. W. A. Parks, University of Toronto	Oct. 7	1254
Mr. Colin Maxwell, Winnipeg, Man.	Oct. 14	1281
Mr. E. L. Horwood, Ottawa, Ont.	Oct. 28	1332
Lt.-Col. C. H. Mitchell, Toronto, Ont.	Oct. 28	1333
Mr. J. F. Connolly, Toronto, Ont.	Nov. 4	1363
Mr. H. S. Van Scoyoc, Toronto, Ont.	Nov. 11	1390
Mr. Clifford Older, Springfield, Ill.	Dec. 23	1560

BRIDGES

Title of Article	Issue	Page
Building the Substructure of the New C. P. R. Kildonan Bridge over the Red River	Jan. 21	67
Erection Features of the Quebec Bridge	Jan. 21	82
The Beautifying of Highway Bridges (by H. G. Tyrrell)	Jan. 28	98
Replacing a Three-Span Cantilever Bridge by an Independent Span	Jan. 28	104
Substructure Work for the Canadian Pacific Railway Bridge at Mud Lake, Ont.	Jan. 28	105
Proposed Second Narrows Bridge at Vancouver	Feb. 11	164
Suspension Bridge over the Kootenay River	Feb. 11	166
The St. Lawrence River Bridge of the C. P. Railway..	Mar. 4	261
Deleterious Effect of Rust in Steel Highway Bridges (by Clifford Older)	Mar. 4	271
Substructural Bridge Work by the Pneumatic Method.	Mar. 11	287
Reinforced Concrete Bridge at St. Catharines, Ont....	Mar. 11	302
Modern Highway Bridge Construction	Mar. 18	318
Deck-Girder Bridge with Girder Lift Span, Kamloops, B.C., over North Thompson River	Mar. 18	329
Weight of Crowds on Bridges and Grandstands	Mar. 18	330
Highway Bascule Bridges of the City of Winnipeg (by H. A. MacKay)	Apr. 1	386
Specifications for Reinforced Concrete Highway Bridges and Culverts	Apr. 1	397
Progress on the Quebec Bridge Construction	Apr. 8	418
Self-Anchored Suspension Bridge at Cologne	Apr. 8	421
C. P. R. High-Level Bridge at Edmonton	Apr. 8	430
How Bridges Expand	Apr. 15	460
Suspension Bridge at New Hazleton, B.C.	Apr. 15	456
Constructional Features of the Georgia-Harris Viaduct at Vancouver, B.C.	Apr. 22	478
Permanent Bridges and their Advantages (by Daniel B. Luten)	Apr. 22	482
Light Floors for Highway Bridges	Apr. 29	512
The Quebec Bridge Anchor Arm Spans	May 6	556
Low Level Bridges at Edmonton (by H. F. Christie).	May 13	596
Recent Developments in Concrete Arch Bridges in Canada (by Frank Barber)	May 13	620
Practical Considerations in Concrete Arch Design (by E. G. Kaufmann)	May 20	640
The New C. N. P. Railway Bridges of British Columbia (by John Lyle Harrington)	June 10	737
Repairing a Settling Bridge Pier	June 10	745
Moving Loads on Bridges	June 17	789
Interesting Bridge Work in British Columbia	July 15	889
The Fundamental Principles of Aesthetic Bridge Design	July 15	894
Don Section, Bloor-Danforth Viaduct, Toronto	July 15	902
The Various Types of Movable Bridges (by W. M. Wilson) (Part I.)	Aug. 5	979
(Part II.)	Aug. 12	1011
Ultimate Strength of Carbon-Steel Models of Quebec Bridge Members	Aug. 5	989
Methods Employed on the Substructural Work of the C. P. R. Harrison River Bridge, B.C.	Sept. 16	1156
Rebuilding the Pitt River Bridge	Sept. 30	1208
Rebuilding a Bridge Five Hundred Years Old	Sept. 30	1211
Economy of Concrete Bridges (by Daniel B. Luten)..	Sept. 30	1217
Canadian Pacific Deck-Plate Girder Spans	Oct. 14	1278
The New Hastings Street Viaduct at Vancouver	Oct. 21	1284
Quebec Bridge Anchor Arm Diagonal and Posts	Oct. 21	1290
Unprecedented Trussed Spans	Oct. 21	1301
Reinforced Concrete Design for Don Section of Bloor Street Viaduct, Toronto	Oct. 28	1313
C. N. R. Bridge Work at Calgary	Nov. 11	1371
Transcontinental Railway Company's Air-Lift Plant at New Quebec Bridge	Nov. 11	1377
Suggested Design in Reinforced Concrete for the Proposed Bloor Street Viaduct, Toronto	Nov. 18	1398
An Expeditious Bridge Contract in British Columbia.	Nov. 18	1405
A Large Trussed Concrete Bridge	Nov. 25	1443
The Ontario Street High Level Bridge at St. Catharines, Ont. (by Herbert L. Clark)	Dec. 2	1459
Floors for Steel Highway Bridges (by Clifford Older).	Dec. 23	1541
Design, Construction and Detailed Costs of the Richelieu River Bridge, Lacolle Junction, Que.	Dec. 30	1574

BUILDING CONSTRUCTION

Explosives and Their Use in Excavation Work for Buildings	Jan. 7	10
Imperfect Plans and Specifications	Jan. 7	19
Conduit Work in a Fireproof Building	Jan. 7	23
Wind Load on Buildings	Jan. 21	88
Prevention of Dampness in Buildings (by Geo. Melson, F.R.I.B.A.)	Jan. 28	107
Correct and Incorrect Methods of Factory Lighting (by G. H. Stickney)	Jan. 28	113
Ten Rules to Eliminate Building Failures	Feb. 18	207
Freezing Process for Foundations	Mar. 4	270
Protective Measures in Building Construction	Mar. 18	332
Water-Hammer in Steam Pipes	Mar. 18	333
Methods Employed in Strengthening an Old Factory Building	Apr. 1	383
Rapid Foundation Work	Apr. 1	385
Bonds in Brickwork	Apr. 1	400
A Practical Discussion of Waterproofing Problems (by L. G. Mauer)	Apr. 8	428
The Modern Type of Cement Gun, and Its Work (by Carl Weber) (Part I.)	Apr. 29	514
(Part II.)	May 6	546
A Warehouse with Girderless Concrete Floors	Apr. 29	520
Methods and Costs of Encasing Steel Structures in Concrete to Prevent Corrosion	Apr. 29	525
Three Types of Fireproof Building Construction (by Thos. M. Goodrich)	Apr. 29	531
Novel Type of Foundations	Apr. 29	533
Underpinning Work-House Adjacent to Tilting Grain Elevator at Transcona	May 6	543
Building an Eighty-five foot Chimney in Seven Days.	May 6	555
The Artistic Possibilities of Bonds and Mortars in Brickwork (Part I.)	May 20	654
(Part II.)	May 27	688
A Symposium on Heating and Ventilation, and some Mechanical Errors of Installation (by Thomas Morrine)	May 20	663
Building Construction in Nova Scotia	May 27	681
Fire-Resistant Construction and Equipment of Buildings	May 27	693
Field Connections in the Equitable Building, New York	June 10	747
The Design of Steel and Reinforced Concrete Pillars..	June 10	750
Foundations, Eccentric and Concentric, and Resulting Soil Pressure (by W. Muir Edwards)	June 17	770
The Part of the Architect in Structural Engineering (by W. E. Brown)	June 17	786
Strength in Brickwork	June 17	788
Ventilation—Artificial or Natural (by Paul W. Goldsbury)	July 8	871
The Foundation Problem in Building Construction	July 8	873

Title of Article	Issue	Page
Safeguarding Buildings Against Fire	July 8	875
Curious Building Laws of Ancient Times	July 8	877
Composition Flooring (by R. W. Page)	July 22	918
Another Aspect of Ventilation	July 22	941
Balcony Framing, McBride Theatre, Victoria, B.C.	July 22	942
Constructional Details in their Relation to Lighting Efficiency	July 29	961
Straightening the North Transcona Elevator (by Alexander Allaire)	Aug. 19	1039
Efficiency and Economy in the Design of Factory Buildings (by W. E. King)	Aug. 26	1070
Cleaning Stone Work	Aug. 26	1075
Notes on Causes of Failure of Stucco Work	Aug. 26	1090
A Public Comfort Station with a New Feature	Sept. 2	1114
Typical Specifications for the Wiring of Residences	Sept. 2	1115
Wall and Column Footings in the Design of Masonry Structures	Sept. 9	1128
The Genesis of Design	Sept. 30	1206
General Points on Moving Large Structures	Oct. 7	1245
The Wiring of Large Public Buildings	Oct. 7	1246
Methods Employed on Pneumatic Foundation Work at Montreal	Oct. 28	1314
Checking Lists for Estimates on Building Work (by L. A. Waterbury)	Oct. 28	1317
Tile Work Decoration	Oct. 28	1324
Fire Prevention	Oct. 28	1330
Cement Gun Construction at the Hospital for the Insane, Whitby, Ont. (by H. B. Magowan)	Nov. 4	1343
System of Unit Concrete Construction as Applied to the Power Buildings at Cedars, Que. (by John E. Conzelman)	Nov. 4	1348
Paving Floors Like City Streets	Nov. 4	1356
Wind Stress on Roofs (by G. D. Mills)	Nov. 11	1386
Construction of Retaining Walls for Deep Basements in Clay Ground	Nov. 18	1416
Comparative Costs of Three Types of Foundation Construction	Nov. 25	1432
The Hennibique System of Ferro-Concrete Construction	Nov. 25	1435
Constructional Features of the Five-Million Dollar Plant of Canadian Vickers, Limited	Dec. 9	1482
A Discussion of Building Factor Costs (by H. L. Green)	Dec. 16	1529

BUILDINGS—DESCRIPTIVE

Title of Article	Issue	Page
Constructional Features of New Dominion Bank, Toronto	Jan. 7	6
New Residence for the Lieut.-Governor of Ontario	Jan. 7	9
Provincial Courthouse Addition, Vancouver	Jan. 14	52
Canada's First Reinforced Concrete Church	Jan. 14	53
The New Weart Block, Vancouver	Jan. 21	79
Canada Cement Company's New Plant	Jan. 21	87
McCallum, Hill & Company's New Building, Regina	Jan. 21	87
Loew Theatre Company's New Building, Toronto	Jan. 21	89
An Interesting Industrial Undertaking in Quebec	Feb. 11	182
Toronto Stock Exchange New Building	Feb. 18	211
Credit Foncier Building, Vancouver	Feb. 18	214
New Vancouver Car Barn of the B. C. E. R.	Feb. 18	215
Adapting a New Extension to an Old Building (Structural Features of the Ryrie Building, Toronto)	Mar. 4	275
Proposed Windsor Hotel, Windsor, Ont.	Mar. 4	276
The New Yorkshire Building, Vancouver	Mar. 4	276
Structural Features of the MacLeod Building, Edmonton	Mar. 11	306
Regina's New Telephone Exchange	Mar. 18	331
New Arts Building for the University of Alberta	Mar. 18	332
Saskatchewan's New Provincial Goal	Mar. 18	334
New Post Office, Mount Pleasant, B.C.	Mar. 18	339
Warehouse of Revillon Bros., Edmonton	Mar. 18	333
The New G. T. P. at Edmonton	Mar. 25	369
Design and Construction of New Veterinary College, Toronto	Apr. 1	401
The Bank of British North America's New Building at Montreal	Apr. 8	434
Sanatorium at Fort Qu'Appelle, Sask.	Apr. 15	458
Structural Features of New Toronto Theatre	Apr. 15	459
Constructional Features of the Herald Building at Calgary	Apr. 29	524
The New Courthouse at Vernon, B.C., and other Structures	Apr. 29	527
The New Provincial Law Courts at Winnipeg (by R. L. Riggs)	Apr. 29	529
New Building for National Trust Company, Montreal.	Apr. 29	530
Ford Motor Company's Proposed New Building	May 6	545
The C. P. R. Terminal Improvements at Vancouver	May 6	559
Toronto's Proposed New Union Station	May 6	560
Steel Structure, Dominion Bank Building, Toronto	May 13	623
Features of the Northern Electric Company's New Plant at Point St. Charles, Que.	May 27	684
C. P. R. Hotel Paliser, Calgary, Alta.	June 10	748
The New St. Charles Hotel, Toronto	June 10	753
Proposed Industrial Building, Calgary	June 10	753
Methodist Book & Publishing House, Toronto	June 10	754
Government Examining Warehouse, Calgary	June 10	756
Proposed Central School Building, North Vancouver	June 17	788
New Vancouver Club Building	June 17	792
Constructional Features of the C. P. R. Banff Springs Hotel	June 24	816
Proposed Hotel Imperial, St. John, N.B.	July 1	838
Extensive Buildings for the Canadian Kodak Company, Limited, Toronto	July 1	839
Proposed Mormon Temple, Cardston, Alta.	July 1	843
The World's Heaviest Office Building	July 1	843
Proposed Registry Office, Toronto	July 15	909
St. Michael's R. C. Church, Montreal	July 15	910
The New Royal Bank Building, Toronto (by J. B. Carswell, B.Sc., A. M. Inst. C. E.)	Sept. 2	1098
New Post Office at St. John, N.B.	Sept. 23	1197
An Orillia Building which Exemplifies Up-To-Date Factory Design	Sept. 30	1220

Title of Article	Issue	Page
The Canadian Pacific Railway's New Six-Storey Warehouse at Toronto	Oct. 7	1232
Constructional Features of a Double-Deck Car Barn at Vancouver	Oct. 7	1252
Proposed St. Denis Theatre, Montreal	Oct. 21	1293
Arrangement and Operation of the Canada Cement Company's Plant No. 1	Oct. 21	1294
New Civic Library for Montreal	Oct. 28	1325
New Police Headquarters at Vancouver	Oct. 28	1326
Design and Construction of the New C. P. R. Hotel at St. Andrews, N.B.	Nov. 4	1346
Features of Recent Additions to the Canada Cement Company's Plant at Exshaw, Alta.	Nov. 11	1378
New Pulp and Paper Mill at Bathurst, N.B.	Nov. 18	1409
New Residence for Students of the University of Saskatchewan	Nov. 25	1440
Design and Construction of the Central Technical School, Toronto	Dec. 16	1511
Building and Equipment of Calgary's New Police Headquarters	Dec. 23	1557
Constructional Features of the Strachan Bakery at Montreal	Dec. 23	1558
Olympia Hotel, Winnipeg,—Details of Design and Construction	Dec. 30	1567

CONCRETE CONSTRUCTION

Title of Article	Issue	Page
Advantages of Reinforced Concrete in Factory Buildings	Jan. 7	18
Decorative Possibilities of Concrete (by C. W. Boynton and J. H. Libberton) (Part I.)	Jan. 14	36
(Part II.)	Jan. 21	70
Building the Substructure of the New C. P. R. Kildonan Bridge over the Red River	Jan. 21	67
Suggested Design for Reinforced Concrete Poles	Jan. 21	86
Bush-Hammering to Relieve Concrete Surfaces	Jan. 28	97
The Beautifying of Highway Bridges (by H. G. Tyrrell)	Jan. 28	98
Substructure Work for the Canadian Pacific Railway Bridge at Mud Lake, Ont.	Jan. 28	105
Use and Cost of Concrete Pedestal Piles	Jan. 28	106
Method of Making Repairs to Montreal Conduit	Feb. 11	171
"Vibrocel" System of Reinforced Concrete (by J. E. Holdcroft)	Feb. 18	202
Concreting in Winter	Feb. 18	214
Reinforced Concrete Caisson Construction in Breakwaters at Goderich, Ont.	Feb. 25	222
Problems of the Waterproofing Engineer (by W. H. Evans)	Feb. 25	238
Failure of Concrete Buildings	Feb. 25	266
Reinforced Concrete Bridge at St. Catharines, Ont.	Mar. 11	302
The Protection of Concrete in Sea-water between High and Low Tide	Mar. 18	322
Test of Flat Slab Floor	Mar. 18	331
Concrete in Factory Construction	Mar. 18	335
Method of Laying a Concrete Floor	Mar. 18	339
The Common Sense of Reinforced Concrete Design and Construction	Mar. 25	349
Concrete in Irrigation Work in the Okanagan Valley, B.C. (by B. P. Little)	Mar. 25	350
Concrete and Concrete Mixers	Mar. 25	370
Forms of Concrete Work	Apr. 8	417
Design and Operation of Tremies for Depositing Subaqueous Concrete (by J. R. Middleton)	Apr. 22	477
Foundations of the Dam across the North Saskatchewan River at Lacolle Falls (by F. A. Creighton)	May 13	615
Recent Developments in Concrete Arch Bridges in Canada (by Frank Barber)	May 13	620
Practical Considerations in Concrete Arch Design (by E. G. Kaufmann)	May 20	640
Reinforced Concrete Storage Dam at Swift Current, Sask. (by W. F. Farley)	May 27	677
Estimating the Cost of Earthwork and Concrete Construction (by L. B. Merriman)	June 3	722
Compound Piling	June 10	746
Mixing and Placing Concrete by Compressed Air	June 10	764
Large Reinforced Concrete Pier at Halifax, N.S.	June 24	810
Reinforced Concrete in Theory and Practice (by Alex. Melville, C.E.) (Part I.)	June 24	818
(Part II.)	July 1	840
How to Patch a Concrete Floor	July 1	842
Field Notes on Saw-Tooth Concrete Roof Construction at Windsor, Ont.	July 8	860
A New Concrete Piling	July 29	958
Reinforced Concrete Log Chute and Dam at High Falls, Quebec	Aug. 26	1068
Bonding Asphalt to Concrete	Aug. 26	1069
Deep Water Concreting through a Tube (by E. B. Van de Greyn)	Aug. 26	1082
Examination of Concrete Failures for their Determining Causes	Aug. 26	1086
Constructional Details of the Concrete House	Sept. 9	1136
Clamps for Splicing Reinforcements	Sept. 9	1144
Puddling or Ramming Concrete after Placing	Sept. 9	1145
The Design and Construction of the Bassano Dam (by H. B. Muckleston)	Sept. 16	1162
Evolūtion of Modern Elevator Construction (by Jas. Spelman, M.Can.Soc.C.E.)	Sept. 23	1182
The Decorative Value of Concrete	Sept. 23	1201
Economy of Concrete Bridges (by Daniel B. Luten).	Sept. 30	1217
New Type of Driver for Large Concrete Piles	Sept. 30	1218
Replacing a 250-ft. Reinforced Concrete Chimney	Oct. 7	1233
Control of Reinforced Concrete Construction (by W. K. Hatt)	Oct. 7	1243
Concrete Poles, and the Possible Maximum Load on Pole Lines	Oct. 21	1292
System of Unit Concrete Construction as Applied to the Power Buildings at Cedars, Que. (by John E. Conzelman)	Nov 4	1348

Title of Article	Issue	Page
Difficulties Encountered in Building a Reinforced Concrete Aqueduct 17 Feet in Diameter (by Geo. T. Seabury)	Nov. 11	1380
Concrete "Lumber" for Mine Shafts	Nov. 11	1387
Suggested Design in Reinforced Concrete for the Proposed Bloor Street Viaduct, Toronto	Nov. 18	1398
An Interesting Piling Contract at Montreal	Nov. 18	1413
Construction of Concrete Septic Tanks (by Percy H. Wilson)	Nov. 18	1414
Causes of Failure in Concrete Structures	Nov. 18	1415
Reinforced Concrete in Municipal Engineering Work	Nov. 25	1422
Causes of Concrete Failures	Nov. 25	1423
Bonding Asphalt to Concrete	Nov. 25	1427
The Hennibique System of Ferro-Concrete Construction.	Nov. 25	1435
A Large Trussed Concrete Bridge	Nov. 25	1443
Protection of Unfinished Concrete	Dec. 16	1525
The Behaviour of Reinforced Concrete in Fires	Dec. 30	1568
Concreting in Freezing Weather and the Effect of Frost Upon Concrete (by J. Hammersley-Hennan)	Dec. 30	1582

CLAY INDUSTRY

Awakening of the Clay Industry (Edit.)	Jan. 7	1
Educational Facilities for the Clay Worker (Letter to Editor), Mr. W. H. Freeborn	Jan. 14	32
Types of Hollow Tile Fireproofing	Feb. 25	243
The Kilgard Fire Clay Company's Plant at Kilgard, B.C.	Apr. 15	461
Color Varieties in Brick	June 24	815
Terra-Cotta in Building Construction (by H. L. Fitzsimmons)	July 29	963
Architectural Terra-Cotta	Aug. 26	1087
Clay and Shale Deposits of the Western Provinces	Sept. 9	1146
Tile Work Decoration	Oct. 28	1324
The Possibilities of Brick in an Educational Exhibit	Dec. 16	1526

EDITORIAL

(Leading Articles)

Awakening of the Clay Industry	Jan. 7	1
Engineering Responsibilities and Lay Administration.	Jan. 14	29
Fair Play to Contractors Tendering for Public Works (Letter to the Editor)	Jan. 14	65
Vulgarity and Obtrusiveness in a New School of Design.	Jan. 28	93
Discussion of Editorial Article, "Engineering Responsibilities and Lay Administration" (Letter to the Editor)	Jan. 28	114
Work and Opportunities of the Canadian Society of Civil Engineers	Feb. 4	125
Maladministration at St. Boniface	Feb. 18	191
The Organization of Engineering	Mar. 4	253
Unsavory Contract Procedure	Mar. 11	285
The Fire Hazard, and its Responsibilities (Woodbine Hotel, Toronto)	Mar. 25	347
Facts and Figures about Building	Apr. 1	379
The Curtain Raised on Toronto's Fire Tragedy (Woodbine Hotel)	Apr. 8	411
Thirty Million Dollars for Ontario Roads	Apr. 15	433
Workmen's Compensation in Ontario	Apr. 22	475
Canadian Municipalities Need Controlling Influence	Apr. 22	475
The Perfect Specification	Apr. 29	507
Protection of Elevated Tanks and Standpipes from Frost	May 6	539
The Layman and Sewage Disposal	May 13	567
Professional Bids	May 20	637
The Making of a Technical Journal	May 27	669
Functions of the Engineering Society	June 3	703
British Trade in Canada	June 17	767
Important Aspects of Contract Reform	June 24	797
The Season of Speech	July 1	827
Canadian Constructional Centres—A Criticism	July 8	857
A Canadian Town Planning Revival	July 15	887
The Human Factor in Depreciation	July 22	917
Vancouver City Council's Unsavory Competition	July 29	947
Preference—A Misnomer	Aug. 5	977
Canadian Constructional Activity—Retrospective and Prospective	Aug. 12	1007
Business Treason in a New Garb	Aug. 19	1037
The Deposit Cheque (Letter to the Editor)	Aug. 19	1061
The European War in Its Relation to Canadian Trade.	Aug. 26	1066
Economy of Adequate Information to Tenderers	Sept. 2	1093
Business Facts About the War	Sept. 2	1094
The Panacea for Pessimism—Work	Sept. 9	1123
Our Contemporaries on the War Crisis	Sept. 9	1124
"Business as Usual"	Sept. 16	1151
Meeting the Present with an Eye to the Future	Sept. 23	1179
An Eye Beyond the Immediate Future	Sept. 30	1205
The Example of the Dominion Government	Oct. 7	1231
The Survival of the Fittest	Oct. 14	1257
The Exigencies of the Present	Oct. 21	1283
An Argument in Hard Facts	Oct. 28	1311
Side-tracking Canadian Contractors	Nov. 4	1337
The Building Owner as a Gambler	Nov. 11	1365
The Hopeful Influence of Trade Adjustment	Nov. 18	1393
"Love Among the Ruins"	Nov. 18	1394
"The Deposit Cheque" (Letter to the Editor)	Nov. 18	1395
The Wielder of the Weapon	Nov. 18	1401
British for British	Nov. 25	1421
The Clay Products Industry and its Approaching Convention	Dec. 2	1449
The Day of the Capitalist and the Prospective Builder.	Dec. 9	1479
The Toronto Technical School	Dec. 16	1509
Dominion Charters Upheld by Privy Council	Dec. 16	1510
Looking Ahead	Dec. 23	1537
The Old Year and the New	Dec. 30	1563
Lessons from the Edison Fire	Dec. 30	1564

ENGINEERING TOPICS IN THE OLD LAND

(Special London Correspondence)

Title of Article	Issue	Page
Proposed Canadian Institution of Municipal Engineers—The Need for a Central Authority to Control Municipal Borrowings in Canada	Jan. 7	4
Concave Roads—Miscellaneous Comment	Feb. 18	193
Responsibilities of the Engineer under Lay Administration—Centralization and De-Centralization—Professional Society Work	Apr. 8	413
Unsavory Contract Procedure—Architects' Estimates—Professional Status	May 20	638
Conservatism and Conservation—Concrete and Brick Roads—Reinforced Concrete	June 3	704
Practice and Malpractice in the Field of Sanitation: A Comparison of Canadian and English Methods	July 1	829
British Trade in Canada. The Currency Question.—"The Road Machine"	Aug. 12	1008
Proposed Municipal Engineering Corps.—The Fresh Air Inlet and the Intercepting Trap	Sept. 2	1095
Trade and the Press.—Commendable Policy of British Authorities in Providing Employment—Unparalleled Opportunity of the Manufacturing Interests	Sept. 16	1152
The Situation and Outlook in the Timber Trade—Engineering and Sex. Licenses at Calgary	Oct. 14	1261
Road Tests.—Siege Gun Platforms.—Competitive Appointments	Nov. 11	1366
The Institution of Civil Engineers.—Comments on Mr. Blythe's Presidential Address.—The Unnecessary Decimal.—A Superfluous Damp Course	Dec. 9	1480

ENGINEERING—GENERAL

Increased Efficiency of Hydraulic Turbines	Jan. 28	94
Proposed Aerial Passenger Cableway across the Whirlpool Rapids below Niagara Falls	Feb. 11	181
Reinforced Concrete Engineers	Feb. 25	225
Present Status of Sun Power	Feb. 25	226
A General Review of Professional and Technical Matters Affecting the Interests of the Engineer	Mar. 4	255
Requirements and Scope of the Consulting Engineer in Water-works Practice	Mar. 11	299
Concrete in Irrigation Work in the Okanagan Valley, B.C.	Mar. 25	350
Is Upward Hydrostatic Pressure or Low Coefficient of Friction Responsible for Recent Dam Failures?	Apr. 15	444
Depreciation in Relation to Municipal Works (by R. O. Wynne-Roberts)	May 13	601
A Retrospect of Municipal Engineering	May 13	606
Engineering Activities of the Department of Marine and Fisheries (by Lt.-Col. Anderson)	May 13	612
The Requirements of the Municipal Engineer (H. N. Ruttan)	June 17	769
Engineering Activities of the City of Edmonton	June 24	802
Constructional Features of the Salmon River Hydro-Electric Development	July 8	862
Hydraulic Fill Levees on the Mississippi	July 29	965
Conscience in Municipal Engineering (by Alfred Williamson)	Aug. 12	1017
Collapse of a Port Arthur, Ontario, Wharf	Aug. 12	1023
Efficient Operation of Dynamite (by Chas. E. Anderson)	Aug. 12	1024
An Engineer's Canoe	Aug. 12	1028
Limitations of Commercial Engineering	Aug. 26	1085
Applied Geology in Municipal Engineering (by Herbert Lackworth, D. Sc. M. Inst. C. E.)	Sept. 2	1100
Recent Developments in the Field of Municipal Engineering (by F. W. W. Doane)	Sept. 16	1160
The Design and Construction of the Bassano Dam (by H. B. Muckleston)	Sept. 16	1162
The Engineer and the Contractor—Their Relation on the Job	Sept. 23	1193
Considerations for the Designing Engineer	Oct. 21	1307
Features of the Principal Types of American Wharf Design	Nov. 4	1352
County and Municipal Engineering	Nov. 11	1367
Pumping Plants on Dyked Lands in British Columbia (by W. P. Dryer)	Nov. 11	1383
Injection of Cement Grout into Water-Bearing Fissures (by Francis Donaldson)	Nov. 11	1385
The Functions of the Municipal Engineer	Nov. 18	1402
Faults of Engineers from the Contractor's Viewpoint	Dec. 2	1472
Uses of the Hydraulic Mining Cartridge	Dec. 2	1460
Developments in Pumping Machinery (by Wm. Perry).	Dec. 16	1524
Publicity for Engineering Work	Dec. 23	1539

GARBAGE COLLECTION AND DISPOSAL

Refuse Disposal Practice in Canadian and United States Cities	Mar. 4	274
Systematic Refuse Disposal for Small Cities and Towns (by S. A. Greeley)	Apr. 15	457
Modern Refuse Disposal Practice at Halifax, N.S.	June 17	773
Design, Test and Cost Data on New Municipal Refuse Incinerator at Regina	July 22	931
Garbage Collection and Disposal at Vancouver	Aug. 5	1002
Profitable Conversion of City Garbage	Aug. 12	1009
Garbage Incinerators and Destructors (by Sterling H. Bushnell)	Aug. 19	1050
Refuse Destruction—The Evolution of Efficient and Economical Methods of Disposal (by R. O. Wynne-Roberts)	Sept. 16	1169
Costs of Collecting, Hauling, Transferring and Transporting Refuse Materials (by S. Greeley)	Dec. 2	1454

Title of Article	Issue	Page
The Disposal of Trades Waste (by J. W. Sheridan)	Dec. 16	1519
Modern Practice in Refuse Disposal (by Prof. E. R. Matthews)	Dec. 23	1554
Preventing Odors in Refuse Disposal Plants	Dec. 30	1573

HARBORS AND WATERWAYS

Title of Article	Issue	Page
Progress, Design and Construction of the New Welland Canal	Mar. 11	294
Hydraulic Dredge for Arrow Lakes, B.C.	Mar. 11	305
The Georgian Bay Ship Canal—Its Proposed Route and Its Economic Importance (by Sir Robt. Perks Bart.)	Apr. 15	455
Fraser River Development	Aug. 19	1060
Lock Gate Lifter for Trent Canal	Sept. 30	1210
Progress of Toronto's Twenty-Five Million Dollar Harbor Development	Sept. 30	1213

MATERIALS OF CONSTRUCTION

Title of Article	Issue	Page
Concrete Tile Blocks Manufactured by Wet Process.	Jan. 21	86
The Qualities of Sheet Asphalt	Jan. 28	111
Paints and their Applications	Feb. 4	151
Waterproofing and Paint for Cement	Feb. 11	175
An Analytical Study of Composition Flooring Material (by H. M. Hooker)	Feb. 25	241
Types of Hollow Tile Fireproofing—Their Manufacture and Burning	Feb. 25	243
Satisfactory Tests of Concrete Sewer Pipe	Feb. 25	260
The Preservation of Structural Steel (by A. H. Sabin).	Mar. 4	272
The Application of Brick in Engineering Construction (by E. E. R. Tratman)	Mar. 18	359
Waterproofing Masonry	Apr. 1	399
The Special Application of the Various Roofing Materials	Apr. 22	494
Rerolled Reinforcing Bars Tested	May 6	555
Present Status of the Marble Industry in Canada (by Dr. W. A. Parks)	May 13	626
History and Development of Waterproofing (by W. H. Evans)	May 13	630
Thermal Properties of Concrete	May 27	683
A Discussion of Coal-Tar and Asphalt Products for Waterproofing (by S. T. Wagner)	May 27	692
The Nature and Utility of Building and Ornamental Stones	June 3	708
Proportioning Concrete Aggregate (by F. C. Snow)	June 3	719
Concrete vs. other Materials for Factories	June 10	747
Frost Resistance of Building Stone	June 10	751
Why Brick Houses are Cheaper	June 17	787
The Bulk Handling of Cement (by H. M. Capron)	June 17	790
The Use of Marble in Architecture	June 24	820
The Use of Hydrated Lime in Concrete Mixtures for Pavements	July 8	868
Selection and Use of Concreting Materials at the McKeesport Water Softening and Filtration Works	July 22	939
Hydrated Lime in Concrete Road Surfaces (by Robert S. Edwards)	July 29	953
Terra-Cotta in Building Construction (by H. L. Fitzsimmons)	July 29	963
Sand and Coarse Material and Proportioning Concrete.	July 29	969
Ultimate Strength of Carbon-Steel Models in Quebec Bridge Members	Aug. 5	989
Efficiency in the Waterproofing of Cement Surfaces (by G. H. Cresser)	Aug. 12	1029
Steel Production in the United States	Aug. 19	1057
Architectural Terra-Cotta	Aug. 26	1087
Paint on Cement or Concrete Surfaces	Sept. 2	1114
Dangers in Bank-Run Material	Sept. 9	1130
Canada The Chief Source of Asbestos Supply	Sept. 9	1145
Interesting Process of Manufacturing Steel Pipe	Sept. 16	1168
Painting Concrete and Cement Surfaces	Sept. 23	1197
A Method of Proportioning Concrete (by Wm. B. Hunter)	Oct. 7	1234
Painting Concrete Surfaces	Oct. 7	1244
Imports of Constructional Materials	Oct. 14	1258
Adding Hydrated Lime to Concrete Mixtures	Oct. 21	1286
Liquids Used in Paints (by A. A. Kelly)	Oct. 21	1305
The Durability of Creosoted Piling	Oct. 28	1329
Specification for Sand in Reinforced Concrete	Nov. 4	1356
Paints for Cement and Concrete Surfaces (by H. B. Magowan)	Nov. 18	1400
Proportioning Aggregates for Portland Cement Concrete.	Nov. 18	1408
Cost of a Damp-proof Timber Floor	Nov. 18	1409
Simple Rules for the Weight of Iron and Steel Bars	Nov. 18	1413
Corrosion of Steel in Concrete	Nov. 25	1423
The Antiquity of Cement	Dec. 2	1458
Copper Alloy for Metal Lath Manufacture (by C. W. Noble)	Dec. 2	1472
Hydrated Lime in Concrete	Dec. 9	1493
Characteristics of Materials (by E. B. Tilt)	Dec. 23	1549
Slag as an Aggregate in Concrete	Dec. 30	1570

MISCELLANEOUS

Title of Article	Issue	Page
Movement of Tall Buildings	Jan. 21	78
Report of the Twenty-Eighth Annual Meeting, Canadian Society of Civil Engineers, held at Montreal	Feb. 4	127
Report of the Twelfth Annual Convention of the Canadian National Clay Products Association, held at Toronto	Feb. 4	133
The Architect and His Relation to the Housing Problem	Feb. 4	135
Montreal Builders' Exchange. Annual Meeting	Feb. 11	185
Engineers' Club of Toronto Annual Meeting	Feb. 11	185
Sanitary Survey of Boundary Waters between Canada and the United States	Feb. 11	178
Crushing Plant of the Martin's International Trap Rock Company at Bruce Mines, Ont.	Feb. 18	199
Digging Trenches and Holes in Frozen Ground	Feb. 18	206
Mouthpiece for Suction Dredges	Mar. 11	293
A Practical Discussion of Estimating Methods in Building Work (by Henry A. Hoyt)	Mar. 11	304
Fairness in Contracts	Mar. 18	325
Contractors' Camp for Workmen on the New Quebec Bridge	Mar. 18	328
Measurement of Gravel in Piles	Mar. 18	330
Power Development at Saxon Falls	Mar. 25	367
Contractors and Conservation	Apr. 1	381
The Art of Making Rapid and Reliable Preliminary Estimates of Cost (by Allen Hazen)	Apr. 1	393
Profit or Loss with the Steam Shovel	Apr. 1	402
Increased Activity at Vancouver	Apr. 8	435
Desirability of Co-operation Between Architects and Contractors (by Chas. A. Bowen)	Apr. 22	496
The Modern Type of Cement Gun, and Its Work (Part I.) (by Carl Weber)	Apr. 29	514
Prize Design for Hydraulic Power Station	Apr. 29	532
Day Labor vs. Contract Work (by J. W. Astley)	May 6	541
The Modern Type of Cement Gun, and Its Work (Conclusion) (by Carl Weber)	May 6	546
Canadian Constructional Centres (Part I.)	May 13	569
Canadian Constructional Centres (Part II.)	May 20	645
Canadian Constructional Centres (Part III.)	May 27	671
Drill Boat for Submarine Blasting at Vancouver, B.C.	May 27	682
Modern Tendencies in Equipping and Operating Structural Shops	June 10	741
Possibilities of the Nail-Head as a Decorative Medium.	June 17	784
The Modern Architect	June 17	789
The Engineer's Estimate, from the Viewpoint of the Contractor	June 24	799
Hydro-electric Development at Cedar Rapids, Que.	June 24	813
Analysis of Factory Building Costs	July 8	870
Underground-Conduit Developments in Montreal	July 8	878
Toronto Union Station Contract Award	July 15	908
Sherbrooke—Its Constructional and Industrial Development	July 22	919
The Standardization of Horizontal Tubular Boilers	July 29	959
Status and Prospects of the Steel Trade in Canada	July 29	970
Mining Operations in Quebec	Aug. 19	1049
The Thirty-Sixth Annual Canadian National Exhibition	Sept. 9	1142
The Preparation of Architectural Drawings	Sept. 23	1195
Canada's Trade with Germany	Oct. 7	1249
Speculations on the Problem of Housing the Working Classes in Vancouver (by R. McKay Frippe)	Oct. 14	1276
Cement in Lumber Dry-Kilns (by G. D. Crain, Jr.)	Oct. 21	1300
Going After Business (by A. A. Briggs)	Oct. 21	1306
A New Type of Creosoting Plant	Nov. 11	1389
The Proper Use of the Technical Journal	Nov. 18	1396
An Eleven-Mile Lumber Flume in British Columbia	Nov. 25	1427
A Menace to Honest Contractors	Dec. 9	1481
The Contractor and Engineering Problems in the Home (by Chas. F. Smith)	Dec. 16	1531
Scholarly Originality in Architecture	Dec. 23	1538
General Principles of Snow Removal	Dec. 23	1548
Definite Expression in Architectural Detail	Dec. 30	1565
Status of Air Ozonation	Dec. 30	1569
Fuel Oil and Its Application	Dec. 30	1572

ORGANIZATION

Title of Article	Issue	Page
Economies in Contracting Operations	Jan. 7	14
What Advertising Means to the Contractor	Jan. 7	20
Organizing and Executing the Construction of a Reinforced Concrete Industrial Building (by Leonard C. Wason) (Part I)	Jan. 14	49
(Part II.)	Jan. 21	80
Purchase of City Supplies	Jan. 21	64
Toronto's Civic Survey Report	Jan. 28	95
Problems and Methods of the Building Contractor	Feb. 11	161
Instructions to Building Inspectors	Feb. 11	163
A Plea for City Planning Organization	Feb. 11	180
Discussion of the Engineer-Manager Plan of Municipal Government	Feb. 25	228
The Application of Business Methods to City Government	Mar. 18	317
Cost Accounting System for Engineering Contractors.	Mar. 18	324
Principles of Efficiency Engineering Applied to Highway Engineering	Mar. 18	340
Cost-Keeping on Constructional Work (by G. L. Shanks)	Apr. 15	445
The Administration of Municipal Works, Especially Relating to Highways (by Nelson P. Lewis)	Apr. 15	447
The Manager Plan of Municipal Government (by Kenyon Riddle)	Apr. 29	508
City Engineers' Office Methods	July 8	864
Management Engineering applied to a Highway Contractor's Organization (by H. B. Drowne)	July 15	900
System, as Applied to the Engineering Department	July 22	928
Training Men in the Contractor's Organization	July 29	954
Advantages of Method in Construction Work	Aug. 5	993
A Contractor's Cost Account System (by C. E. Anderson)	Aug. 12	1018
The Organization of the Municipal Engineer's Department (by Edward Willis)	Aug. 19	1042
The Organization and Management of the Stores Department (by W. G. Astley)	Aug. 26	1076
The City Manager Plan of Municipal Government (by P. E. Kressly)	Sept. 2	1112

Title of Article	Issue	Page
Day Labor vs. Contract Work	Sept. 16	1155
Cost Accounting and Its Importance on Construction Work (by Leslie H. Allen)	Sept. 23	1189
The Concrete Superintendent	Sept. 30	1222
The Value of a Library in an Engineering Office (by L. B. Krause)	Oct. 7	1241
Control of Reinforced Concrete Construction	Oct. 7	1243
Reporting on Public Service Properties (by E. P. Roberts)	Oct. 7	1247
The Cost of Doing Business as a Factor in Contract Work (by Edwin L. Seabrook)	Oct. 7	1250
Does the Publication of Costs Endanger the Contractor?	Oct. 14	1259
The Value of System in Contract Work (by G. Crain, Jr.)	Nov. 25	1434
Methods Which Make for Profit or Loss in Estimating.	Dec. 16	1522
Examples of Estimating Methods Practised by English Contractors	Dec. 30	1579

RAILWAYS

To Set out Spirals by Offsets from Long Chord (by E. S. M. Lovelace)	Jan. 14	46
The Mount Royal Tunnel Entry into Montreal for the Canadian Northern Railway	Feb. 4	136
Constructional Features of the B. C. Division of the Canadian Northern Pacific Railway	Apr. 1	396
The Double-Track Tunnel of the C. P. R. through Mount Macdonald, B.C.	Apr. 8	415
Tunnel Construction and Ventilation for Railroads..	Apr. 15	446
An Important Terminal Scheme	June 17	772
Proposed Ocean and Railway Terminals at Halifax, N.S.	July 22	938
Making Railroad Fill from Pontoon Bridge	July 29	957
Costs and Other Features of Surfacing Tracks	Aug. 5	998
Constructional Features of the Algoma Eastern Railway	Aug. 19	1046
Tunnel Work on the Grand Trunk Pacific	Aug. 19	1048
The C. P. R. Double-Track Tunnel through Mount Macdonald, B.C.	Sept. 9	1127
Large Works Completed by the C. P. R.	Sept. 30	1228
Heavy Construction Work on the G. T. P. Railway	Oct. 21	1286
Building Bridge Substructures on the G. T. P. Ry...	Oct. 21	1287
The Relation of Geology to Railway-Tunnel Location (by Edwin C. Eckel)	Oct. 28	1320
The Construction of the Canadian Northern Pacific Railway (by J. V. Nimmo)	Nov. 18	1406
Tunnel-Boring Records Broken	Dec. 23	1548
Problems of Railway Sanitation (by E. J. McCaustland)	Dec. 23	1555

ROADWAYS AND PAVING

Title of Article	Issue	Page
Water-Bound Macadam Roads	Jan. 7	16
General Methods of Repairs and Renewals in Road Work (by A. W. Dean)	Jan. 14	51
Wood Block and Asphalt Block Pavement	Jan. 21	84
Avoidable Defects in Concrete Paving	Feb. 11	167
Permanency in Modern Road Building	Feb. 11	168
Suggestions for the Utilization of Granite Block Pavements	Feb. 11	169
Construction of Creosoted Wood-Block Pavements (by R. S, Manley)	Feb. 18	212
Good Roads Association of Ontario.—Report of Twelfth Annual Meeting, Toronto, Feb. 24-6	Mar. 4	279
Practical Discussion of Reinforced Concrete Pavements.	Mar. 18	338
Principles of Efficiency Engineering Applied to Highway Engineering	Mar. 18	340
Present-Day Practice in Concrete Road Construction.	Mar. 25	360
Recommendations for Concrete Road Building	Mar. 25	361
Relative Economy of Constructing Bituminous Concrete Pavements and Bituminous Pavements by Penetration Methods (by Geo. C. Warren)	Mar. 25	362
Portable vs. Stationary Asphalt Plants (by J. W. Astley, C.E.)	Mar. 25	363
Brick Roads Without Permanent Curbs or Edging.	Apr. 1	400
Materials and Methods in Producing Satisfactory Road Carpets (by Major W. W. Crosby)	Apr. 8	431
Brick Pavements as an Investment (by W. T. Blackburn)	Apr. 15	465
Technical and Economical Aspects of Road-Building in Quebec (by Gabriel Henry) (Part I.)	Apr. 22	497
(Part II.)	Apr. 29	534
Cracking in Concrete Roads	Apr. 29	509
Recent Developments in Concrete Highway Construction (by L. S. Bruner)	Apr. 29	510
Macadam Road Maintenance (by E. A. James)	May 13	592
Brick Pavements -Their Maintenance and Repairs (by F. F. Townsend)	May 13	594
The Value of Cost Data in Highway Engineering (by Major Crosby)	May 20	664
Montreal Road Congress	May 27	695
Modern Bituminous Surfaces and Pavements	June 10	742
The Proper Care of Road Machinery	June 10	745
Concrete Roads vs. Foundations (by Major W. W. Crosby)	June 17	775
Engineering Activities of the City of Edmonton	June 24	802
Advantages of Brick Paving	June 24	805
The Economics of Brick Pavements	June 24	821
Specifications for Slag Foundation for Brick Pavements	June 24	821
Ontario Commissioners' Valuable Report on Highway Administration	July 1	844
Methods and Cost of Constructing a Bituminous Gravel Concrete Surface	July 1	848
Cracking in Concrete Roads	July 1	849
Road Designing (by Robert A. Meeker)	July 15	902
An Analysis of Worn-out and Ravelled Macadam Surfaces, with Suggestions as to Treatment	July 15	904
Hydrated Lime in Concrete Road Surfaces (by Robert S. Edwards)	July 29	953
The Construction of Creosoted Wood Block Pavements (by R. S. Manley)	July 29	960
Method of Finishing Concrete Alley Pavements	Aug. 5	996
Burned Asphalt Cement Can Be Prevented	Aug. 12	1010
Practical Points in Modern Roadwork (by W. H. Maxwell)	Aug. 12	1021
Good Roads as Crop Producers	Aug. 19	1038
Grouting and Penetrating Methods of Road Surfaces..	Aug. 19	1058
The Selection of Asphaltic Material for Road Construction	Aug. 26	1088
The Selection of Pavements for Roads and Streets (by W. H. Connell)	Sept. 2	1107
An Unsupported Pavement (by H. H. Macdonald)...	Sept. 2	1109
The Prevention of the Sub-Crust Movement in Roads	Sept. 9	1135
The Economy of Wide Roads (by Thos. Adams)	Sept. 16	1154
Concrete Highway Construction at Montreal	Sept. 23	1191
The Salvage of Road Hauling Machinery	Sept. 30	1212
Shoulders for Concrete Roads	Sept. 30	1219
Economic Factors Involved in Road Construction in Strictly Rural Sections	Sept. 30	1224
Waves in Road Crusts	Oct. 7	1236
Economy and Efficiency in Pavement Construction (by H. B. Pullar)	Oct. 7	1238
The Meaning of "Macadam"	Oct. 7	1240
The Pacific Coast Highway	Oct. 14	1263
The Selection of Dust Preventives	Oct. 21	1289
Bituminous Surfaces for Concrete Roads (by W. H. Fulweiler)	Oct. 21	1304
A Discussion of Traffic Factors (by J. Eastwood)	Oct. 28	1322
Data Relating to Wear and Costs of Concrete Roads, with Details of Maintenance Expense (by W. S. Shaw)	Nov. 4	1357
The Effect of Leaking Illuminating Gas on Bituminous Pavements (by Geo. C. Warren)	Nov. 4	1359
Slag Macadam for Road Paving	Nov. 4	1360
A Discussion of the Relative Values of Paving Material	Nov. 11	1373
The Brick Road, and Its Construction (by Jac. McCleary)	Nov. 11	1376
Portland Cement Concrete as a Paving Material	Nov. 18	1410
Details of Construction which make Brick Pavements Good or Bad (by F. A. Churchill)	Nov. 18	1411
Hammer Drill Used in Cutting Pavement with Concrete Base	Nov. 25	1426
English Specifications for a Bituminous Concrete Mixing Plant, and Details of the Acceptance Test...	Nov. 25	1430
Cracks in Concrete Roads	Nov. 25	1421
Concrete Roads—Their Design, Specifications and Present Status (by A. A. Young)	Nov. 25	1444
Concrete Roads, Their Design, etc. (Conclusion)	Dec. 2	1474
Drainage Structures (by W. E. Atkinson)	Dec. 2	1456
The Maintenance of Earth Roads (by Geo. W. Cooley).	Dec. 2	1457
Tar-Macadam Work on Roads	Dec. 2	1458
Road Construction Plant and the Contractor	Dec. 9	1504
Recent Practice in Bituminous Construction and Maintenance (by Wm. D. Uhler)	Dec. 16	1516
The Selection of Road Machinery (by T. R. Agg).	Dec. 23	1544
Concrete Road Construction (by H. J. Kuelling)	Dec. 30	1577

SEWERAGE AND SEWAGE DISPOSAL

Suggested Designs for Sewage Treatment Plants for Residences and Small Institutions	Feb. 18	218
Fundamentals of an Extended Experience in Sewage Disposal	Feb. 25	235
Perco-Filters for Sewage—Diagram for Ascertaining their Dimensions	Mar. 18	326
Lessons from the Sewage-Treatment Plant of Columbus, Ohio	Mar. 18	327
The Design of Sewage-Treatment Works in Saskatchewan	Mar. 25	365
Small Sewage Pumping Plants (S. A. Greeley and Langdon Pearse)	Apr. 8	427
Explosions in Sewers—An Investigation of Causes and Preventive Measures (by H. J. Kellogg)	Apr. 22	480
Progress Records on Sewer Work	Apr. 29	513
Process for the Utilization of Sewage Sludge	May 6	554
New Sewage Disposal Plant at Worcester, England..	May 6	555
The Layman and Sewage Disposal	May 13	567
The Evolution of Sewage Disposal Methods in Canada (by T. Aird Murray)	May 13	580
The Design and Value of Sedimentation Basins (by Alexander Potter)	May 13	598
The Weston, Ontario, Sewerage System	May 20	639
Separate and Combined Sewers in their Relation to Sewage Disposal (by John H. Gregory)	June 17	782
The Engineering Activities of the City of Edmonton.	June 24	802
Water-tight Sewer Pipe Joints (by E. J. Fort)	June 24	814
Explosive Gases in Sewers, and Precautionary Methods (by G. J. White)	July 8	866
Regulations Governing Plans for Waterworks and Sewerage	July 18	890
Disinfection of Sewage, and its Success in a Small City (by Frank A. Nikirk)	July 18	897
Sewage Disposal for the Country Home (by Benj. Brooks)	July 18	898
Grades and Leakage in Intercepting Sewers	July 18	906
Cement Joints for Sewer Pipe at Edmonton, Alta. (by J. M. Begg)	July 22	936
Sewer Construction and Sewage Treatment	July 22	941
An Interesting Discussion	July 29	966
Drainage and Sanitary Fittings in Canada (by Fred Osborne Smith)	July 29	966
Design and Construction of Intercepting Sewers, with Special Reference to Minimizing Infiltration	July 29	968

Title of Article	Issue	Page
Sewer Excavation with a Revolving Shovel	Aug. 12	1010
Modern Methods of Preventing Explosions in Sewers.	Aug. 12	1027
Cement Joints in Sewer Pipe	Aug. 12	1030
Sewage Disinfection in Actual Practice (by Wm. J. Orchard)	Aug. 19	1054
Oxidation of Sewage without the Aid of Filters	Aug. 19	1056
Dilution and Sewage Treatment	Aug. 26	1084
The First Unit of Vancouver and Districts' Great Sewerage Scheme	Sept. 2	1104
Experiments in Sewage Treatment	Sept. 2	1106
Methods of Sampling Sewage and other Liquids (by G. Bertram Kershaw)	Sept. 9	1131
Chilliwack, B.C., Sewerage Scheme	Sept. 23	1181
Relative Values in Sanitation (by Geo. C. Whipple)	Sept. 23	1198
The Efficient and Inoffensive Treatment of Sewage (by Rudolph Hering)	Oct. 14	1268
Costs and Methods of Building Large Sewers (by H. R. Abbott)	Oct. 14	1272
Sewage Disposal Works in European Cities (by Geo. E. Datesman)	Oct. 28	1328
Remodelling a Septic Tank and Contact Filter Sewage Plant (by Alexander Potter, New York)	Nov. 4	1358
Points of Interest in New Electrolytic Sewage Treatment	Nov. 11	1382
Construction of Concrete Septic Tanks (by Percy H. Wilson)	Nov. 18	1414
Bricklaying Costs for 5 to 10 ft. Brick Sewers at St. Louis, Mo. (by C. L. French)	Nov. 25	1431
The New Sewage Disposal Plant at Aberdeen, S.D. (by W. G. Potter)	Dec. 2	1462
Economics of Sewage Filters	Dec. 2	1470
New Sewage Disposal Plant at Aberdeen, S.D. (Conclusion)	Dec. 9	1494
An Investigation of the Discharge of Inflammable Wastes into Sewers	Dec. 9	1501
Sewage Pumping Equipment at Chilliwack, B.C.	Dec. 30	1587

TOWN PLANNING

Title of Article	Issue	Page
J. W. B. Blackman on Town Planning	Apr. 1	399
Report of Sixth National Conference on City Planning, Toronto	June 3	706
Some Observations on the First Draft of the Town Planning Act (by R. O. Wynne-Roberts)	July 1	831
The Evolution of a Business Street	July 8	865
A Town Planning Scheme; Its Effect on Housing and Architecture (by Raymond Unwin)	July 22	923
An Example of Successful City Planning in Germany	Sept. 2	1096

WATER SUPPLY

Title of Article	Issue	Page
Increased Consumption of Water following Filtration.	Jan. 7	2
The Toronto Filtration Plant	Jan. 14	29
The Toronto Filtration Plant (Letter to the Editor) (by Mr. Allen Hazen)	Jan. 14	31
Methods and Results of Water-Works Test for City of St. Boniface, Man. (by G. L. Redmond, Winnipeg)	Jan. 14	34
Economics of the Water Meter	Jan. 21	85
Proposed Extension of Toronto's Water-works System	Feb. 4	152
Report on Pollution of Water Supplies	Feb. 11	160
Method of Making Repairs to Montreal Conduit	Feb. 11	171
Economic Conduit Location	Feb. 11	173
History of the Montreal Water-works, with an Outline of Present Improvements	Feb. 11	176
Port Alberni and Salmon Arm Water-works	Feb. 18	200
Proposed Aqueduct for the Additional Water Supply of the City of Winnipeg	Feb. 25	231
Lay-out of New Water Supply System for the City of Victoria, B.C.	Mar. 4	267
New Power and Water-works Plant, Merritt, B.C.	Mar. 4	278
Montreal Water Conduit	Mar. 11	310
Examples of Poor Design and Improper Operation of Small Water Purification Plants	Mar. 25	364
Operation of Small, Rapid Sand Filters	Apr. 8	423
Economic Design of Standpipes and Conduits	Apr. 8	433
Mechanical Filtration	Apr. 8	434
Construction Plant and Methods Employed in Placing the Cofferdam for the New Intake Power of St. Louis Water-works	Apr. 15	449
The Control or Prevention of Stream Pollution (by Paul Hansen)	Apr. 29	521
Typhoid and Paratyphoid along the Richelieu River	Apr. 29	523
Protection of Elevated Tanks and Standpipes from Frost	May 6	539
The Efficient Operation of Water Purification Plants (by H. P. Letton)	May 6	552
New Water Supply for Winnipeg	May 6	555
The Meter System as a Preventive of Water Waste (by Herbert J. Bowman)	May 13	586
Extensions to Hamilton Water-works (by W. Hollingworth)	May 13	588
Caisson Type of Infiltration Reservoir, Sarnia, Ont., Water-works (by H. A. McLean)	May 13	603
Reinforced Concrete Storage Dam at Swift Current, Saskatchewan (by W. F. Farley)	May 27	677
The Efficiency of Water-works Devices	May 27	679
Purification of Water by Ultra-Violet Rays (by Max Von Recklinghausen)	June 3	705
The Self-Purification and Care of Water Stored for Public Supply Purposes	June 17	779
Greater Winnipeg Water Supply	June 17	796
Construction of the Klondike Pipe Line (by W. W. Edwards)	June 24	808
Elevated Steel Water Tower at St. Thomas, Ont.	June 24	809
Cost of Constructing and Operating Slow and Rapid Sand Water Filtration Plants	July 1	834
Violet-Ray Sterilization for Niagara Falls Filters	July 1	849
A Novel Water Filtration Plant for Toronto	July 8	859
Sterilization of Water by Ultra-Violet Rays	July 15	888
Regulations Governing Plans for Water-works and Sewerage	July 15	890
Softening Water Supplies	July 15	907
An Outline of Present-Day Practice in Water Filtration	July 22	934
Selection and Use of Concreting Materials at the McKeesport Water Softening and Filtration Works	July 22	939
Water Level Indicators and Recorders	July 22	940
Emergency Water Supply System for Montreal (by Frederick E. Field)	July 29	948
The Results of Hypochlorite Treatment of Water	July 29	956
Bacillus Coli in Water Supply—Its Significance and Importance (by Jos. Race)	Aug. 5	991
Dual System of Water Supply and Distribution	Aug. 5	1000
Calcium Hypochlorite as a Water Disinfectant	Aug. 19	1053
Water Sterilization by Ultra-Violet Rays	Aug. 26	1074
Curtailment of Water Waste and Selection of Meters at Milwaukee Water-works.	Sept. 2	1110
Ottawa River Water Supply	Sept. 9	1126
The Efficient Design of Small Water-works Systems.	Sept. 9	1139
Some Water-works Engineering Mistakes (by D. H. Maury)	Sept. 23	1192
The Use of Filter Wells and Filter Cribs	Sept. 30	1223
Economics of Waste in Cities (by R. O. Wynne-Roberts)	Oct. 14	1264
Permissible Pollution in Raw Water to be Filtered for Domestic Use (by Geo. W. Fuller)	Oct. 21	1302
Limitations of Water Filters (by Geo. W. Fuller)	Oct. 28	1318
Ottawa's "Water-works Muddle"	Nov. 4	1338
A Discussion of the Process of Pumping Wells by Compressed Air (by W. O. Smith, A. M. Can. Soc. C. E.)	Nov. 4	1339
Uniformity in Compiling and Reporting Statistics of Water Purification Plants	Nov. 4	1354
Standards for the Turbidity of Water	Nov. 11	1379
Difficulties Encountered in Building a Reinforced Concrete Aqueduct 17 feet in Diameter (by Geo. T. Seabury)	Nov. 11	1380
Pumping Water by Compressed Air (by Geo. C. Thompson)	Nov. 11	1383
Proposed Water Storage on the Upper St. Maurice River, Province of Quebec (by J. W. Thurso)	Nov. 25	1424
The Field of the Slow Sand Filter	Nov. 25	1429
The Greater Winnipeg Water Supply from Shoal Lake (by D. MacLean)	Dec. 2	1451
Water-Works Service in Pipes	Dec. 23	1547

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